

THE SUBSIDIZING OF RESEARCH ABILITY¹

Science has languished in the Philippines. Considering the immense fields for accomplishment, and the unusually interesting problems that fairly swarm about waiting to be solved, and the very able men who have worked here in the past, the question comes up, "Why is it thus? Why is science lagging in the Philippines?"

The answer is this: Chiefly, because from the commencement of the American occupation there has been a desire on the part of the administrators of the Islands to make the Philippines self-supporting. This is an admirable ideal, but not the one followed by those nations that are most far-sighted and capable in colonial development. Nor is this ideal any better adapted for insuring rapid progress in things scientific than it is to expect a school boy to be self-supporting, and at the same time do the best work in his classes.

A second difficulty has been that there is not an adequate appreciation on the part of the Government of the value or need for sufficient accrued leave or furlough time for scientific workers to permit of over-seas study. This is also contrary to the policy of those nations which are achieving the most progress in tropical outposts. Quite aside from the effects of the tropical climate, which should be counterbalanced for the native of temperate climates by at least one year out of the tropics in five or six, there has been little realization in the Philippines of the need of the scientist to travel in Europe, in the United States, or more particularly in other parts of the Orient to refresh himself by contact with others in his line of work, or to take up definite courses of study at universities or other research institutions. Such opportunities to travel and study abroad are many times more necessary for the scientific worker in the Philippines than for the average worker in these lines in the United States or in Europe, for here there are practically no fellow workers, so desirable for co-operation and stimulus. There is hardly a case where there is more than one worker in a large field.

Moreover, the penalty that is paid by the scientist here, because of the isolation, accentuated through lack of adequate leave arrangements, is not compensated for by adequate salary return—he can neither afford to go abroad at his own expense on leave without pay, nor will the Government send him officially. Japan, very logically, requires her technical men to go abroad about once in every five years, to keep abreast of the times and this is very properly done on official time at government expense.

¹ General contribution from the College of Agriculture No. 175.

Of course, the young, recently returned pensionado or fellowship holder, does not need to go abroad again soon. But after a number of years service here, following advanced study abroad, there is again the need for further study and renewal of the contacts, as some of the oldest foreign-trained Filipino scientists are already appreciating. Science progresses so fast, and we are so far from the centers where the real progress is being made, that we almost have to renew the personal contacts occasionally, in order to work effectively, or even to keep from dropping into the deadly rut that means no real scientific output at all.

With the above reasons (lack of sabbatical year arrangements, low salaries, and extreme isolation) ever in the mind of the scientific worker, is it small wonder that almost without exception no scientific men have been long engaged in scientific work in the Philippines? After a few years, usually after the expiration of the short-time contract (which, for many reasons, is much too short), the workers leave the Philippines to continue their scientific work elsewhere under better conditions, or, if remaining in the Islands, forsake the scientific calling for commercial or other lines of activity.

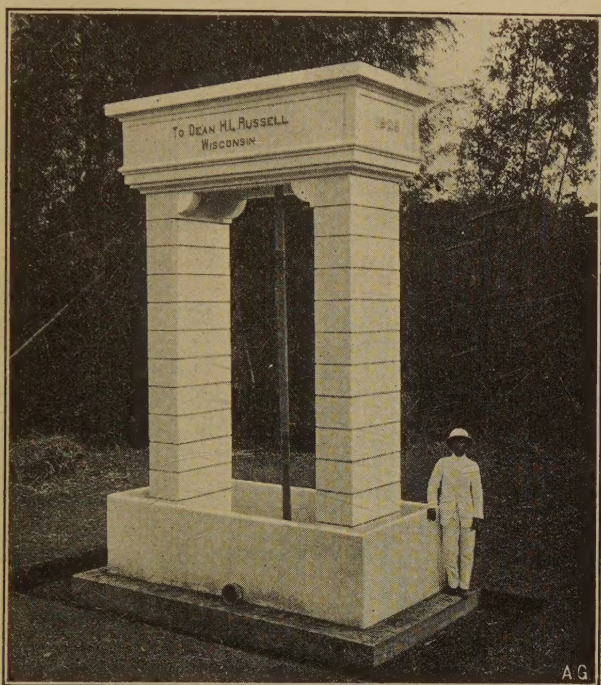
Taken by and large, the struggling researcher has seen no future in the Philippines, and has given up in discouragement. What a great encouragement it is, therefore, that a representative of one of the great educational organizations² of the world spent some time on the Campus last February, studying the questions of the general advancement of science in the Islands, and the assistance that might be given to the higher staff to assist in the scientific development. Dean H. L. Russell, of the College of Agriculture, University of Wisconsin, is spending a year studying the educational and scientific institutions of the countries in and about the Pacific—Hawaii, Japan, China, the Philippines, Siam, the Straits Settlements, the Dutch East Indies, Australia, and New Zealand. Doctor Russell studied our local situation very thoroughly, and was able to make a number of valuable suggestions and constructive criticisms covering our problems.

But most important of all, and most encouraging to the isolated and often rapidly-going-out-of-date members of our faculty, Dean Russell is perfecting arrangements for fellowships at other centers of scientific research—fellowships that will in a great measure make up for the lack of inducements offered by the Insular Government; fellowships that will enable the best members of our staff to enjoy that most valuable opportunity, that of studying with the best scientists in their particular lines, whether it be in Australia, Java, Japan, or further, in Europe, or in the United States. But, particularly, we look forward to the great advantages of a closer contact with the leaders of science in the East—men who can

² The International Education Board, liberally endowed by Mr. John D. Rockefeller, Jr., has for its object the promotion of research in all countries, as a corollary and logical result of higher education.

often be of more help to our workers here than the best men of Europe or America, who have had no experience with either the tropics or the Orient.

The first result of these fellowship arrangements is that one member of our staff, Dr. N. B. Mendiola, is about to leave for a year of such study with Doctor Koch of Buitenzorg, Java. This opportunity will mean very much to Doctor Mendiola as well as for the future of plant breeding for the Philippines. It is understood that arrangements for the granting of fellowships to other members of the staff have been taken in hand.



The concrete stand-pipe dedicated to Dean Russell of the University of Wisconsin, Asiatic Director of the International Education Board.

Truly, this step taken by the International Education Board has meant the dawning of a new day for the Philippine scientist, and the coming of Dean Russell signalized it. At the time of the Dean's visit here there was under construction, near the Administration Building of the College, a concrete stand-pipe and distributing box at the terminus of the main pipe-line which supplies the Campus with water from Mount Maquiling. It seemed fitting, therefore, to utilize this opportunity to preserve in a permanent fashion the name of him who brought to our Campus the Glad Tidings. Hence, quietly, and without any special ceremony or dedication, as is befitting the work of a scientist and characteristic of the man, Dean Russell's name was writ in cement, that those who come may not forget.

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THE SABBATICAL YEAR IN AMERICA

Colleges have found that it pays to give their professors a year's leave after six years of continuous service on the faculty. Travel and new points of view provide fresh enthusiasm and increased usefulness for the work of teaching—dividends to refute any charge that the arrangement is a costly luxury without benefits.

Editorial note in *The Nation's Business*, July, 1926.

HERITABLE CHARACTERS OF HIBISCUS: I. PRESENCE OR ABSENCE OF LOBES ON LEAVES OF YOUNG PLANTS¹

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WITH SIX TEXT FIGURES

INTRODUCTION

One of the most striking characters of seedlings of *Hibiscus rosa-sinensis* is the presence or absence of lobes on the leaf. While there are different degrees of lobation the contrast between a lobed leaf and one which is entire or merely serrated is sharp.

According to lobation, young seedling plants of *H. rosa-sinensis* may be classified into two main groups: (a) That formed by seedlings the leaves of which from the first to the last are not lobed. At no time in the life of the plant does a lobed leaf appear. (b) That formed by seedlings the first one or two leaves of which are entire, but the rest of the leaves, beginning with the third, are lobed. Some plants, as No. 346 in the College Plant Breeding Nursery, had entire leaves from the first to the sixth, before lobed leaves were produced. As the plants of this group grow taller, the lobe of the leaf gradually diminishes in depth until it disappears entirely (see fig. 1). Under this condition the mature plant is dimorphic as regards the condition of the leaf, the leaves at the lower part of the main stem or branch being lobed, while those at the uppermost parts are entire. This



Fig. 1.—Seedlings No. 73 and No. 260 showing the lobed juvenile leaves, the gradual decrease in depth of lobing in leaves as plants became taller and the unlobed climax leaves.

¹Experiment Station contribution No. 394. Read before the Los Baños Biological Club, February 9, 1926. Received for publication August 30, 1926.

form of dimorphism is opposite to that observed by Sears (1922) in *Taraxacum laevigatum* and *T. vulgare* in which "the first leaves of a seedling (juvenile leaves) tend to be entire and smooth—later becoming more dissected and generally more hairy—". Similarly, Shull (1909) reported that the juvenile leaves of all the elementary species of *Bursa* are entirely unlobed while the climax leaves are lobed.

Referring again to *Hibiscus* seedlings, it has been observed that if from a stem or branch a portion is severed and planted, the new individual arising from the cutting repeats the history of its parent plant; that is, it produces lobed leaves during its early age, and entire during its mature period, the transition from the first to the second stage being gradual.

Besides the two groups of seedling *Hibiscus* named, a third may be cited which includes very few individuals. The behavior of the individuals in this third group may be said to be erratic. By this is meant that lobed and not-lobed leaves are produced in a plant alternately, almost, several times before it settles down to one kind of leaf. To cite instances: Seedling No. 344 produced leaves as follows, beginning with the first; entire, slightly lobed, more lobed, slightly lobed, more lobed, not lobed, deeply serrated, deeply lobed, deeply lobed, the rest being deeply lobed. This seedling is expected to produce entire leaves, subsequently, as plants of the second group. Seedling No. 345: not lobed, not lobed, not lobed, lobed, slightly lobed, not lobed, not lobed, very slightly lobed, lobed (at this stage it is assumed to have reached the condition of those in the second group). Seedling No. 349: not lobed, not lobed, slightly lobed, not lobed, slightly lobed, not lobed, not lobed, slightly lobed, lobed, lobed (then probably in the second group). These observations were made on February 25, 1925. On June 8, 1925, these three plants, Nos. 344, 345, and 349, were still producing lobed leaves.

The causes and purposes of leaf dimorphism in plants are not well understood. Sears quotes De Varigny as attributing the dissection of leaves of *Taraxacum* to dry conditions of the soil and entire leaves to hydrophytic environment.

The present paper deals with the inheritance of the presence or absence of lobing in the leaves of *Hibiscus rosa-sinensis* at the juvenile stage. For convenience, such leaves may be termed juvenile leaves.

Review of literature

From such literature as is available, it would appear that the factor for lobing of leaves varies in its behavior, according to species. It appears evident also that there are several different kinds of factors for corresponding kinds of lobing.

Leake (1911), for example, found that true breeding types of cotton could be recognized from the narrowness or broadness or the depth of lobing.

When a narrow lobed type was crossed with a broad type, the F_1 was found intermediate in lobing, and the F_2 suggested a segregation of 1: 2: 1, the middle class being like the F_1 .

Regarding the intermediacy of the F_1 , about the same result was obtained, as suggested by a published photograph, by Allard (1910) who crossed Okra and Keenan cottons.

Shull reported that the juvenile leaves of all the elementary species of the genus *Bursa* are entirely unlobed, but the climax leaves are lobed. He mentioned further that a dimmer light caused the appearance of shallower lobes. Besides shading, he mentioned other conditions, such as crowding, shading, poor soil, drought, the attack of insects, and other factors which diminish the vigor of the plants, as arresting the juvenile stage of the plant. None of these factors, however, has been reported to completely inhibit or suppress the appearance of the juvenile characters of the plants.

In the case of the materials of the present study, differences in the moisture or water conditions of the soil do not cause the presence or absence of lobes in the seedling leaves of *Hibiscus*. This is shown by the fact that seedlings may differ as to the lobing of the leaves even when growing under practically identical conditions in a very small compass as to soil, even in very small pots, and watered and treated otherwise in the same way.

Sears cites Goebel as quoting evidence that "segmentation is 'richer' in temperate than arctic forms, and in 'well-nourished' plants than in 'half-starved' meadow-moor forms." Possibly the condition found in *Hibiscus* belongs in the same category as those phenomena called metaphany, which is defined as internal hydridism. Such changes are considered to give increased utility to the organs affected and to render the organism more efficient (Cook, 1923).

THE EXPERIMENT

With the exception of varieties Native Red Single and Two Days, all parent plants used in this experiment are seedling varieties raised in 1920 and 1921; some of them having been described in a previous report (Mendiola and Capinpin, 1923).

The Native Red Single is the variety most commonly grown and is probably the oldest variety in the Philippines. Two Days is a variety found only (as far as can be ascertained at present) in San Pablo and Los Baños, Laguna Province. The description of the juvenile leaves of the varieties involved in this work is given in table 1.

TABLE 1

Description of juvenile leaves of the varieties used

VARIETIES WITH LOBED LEAVES	VARIETIES WITH UNLOBED LEAVES
1. Pink—6	14. Almost White
2. Orphan	15. (P.×A.)—4
3. Unknown—4	16. Two Days
4. Unknown—7	17. (P.×A.)F ₂ —9
5. Dwarf Pink	18. Pink—1
6. 19 Pink 12396—104	19. Unknown—1
7. Medium Yellow	
8. Pink—14	
9. Pink—10	
10. (H. S.×N. R.)	
11. Native Red Single	
12. (N. R.×H.S.)—4	
13. Morning Lilac	



Fig. 2.—Offspring of Dwarf Pink (LL) produced by artificial self-pollination. Note that all are lobed. The seedlings in the box bear the pedigree numbers 2087 to 2111.

All the seedlings studied grew from seeds which were produced by artificial pollinations. The first pollination was made on September 18, 1924, the last, on March 3, 1925. Almost invariably the *Hibiscus* pod matures 30 or 31 days after the flower is pollinated. In this work the seeds were gathered as soon as the pods matured, and sowed the day of gathering or two or three days after. Germination usually takes place within about

20 days after sowing. The last observation on the leaves was made June 15, 1925.

RESULTS OF THE EXPERIMENTS

From the data obtained which are here presented and discussed, it was concluded that the presence of lobes in the juvenile leaves of *H. rosa-sinensis* is a simple Mendelian dominant over its absence. The homozygous dominant may be represented by the formula LL , the homozygous recessive by ll and a heterozygote by Ll . The evidence supporting the foregoing conclusions may now be discussed. The evidence comes (1) from the results of self-pollination, and (2) from the results of cross-pollination.

Results of self-pollination. If the assumptions as regards the formulæ given above are true, varieties with lobed leaves may be either (a) homozygous, and give only lobed offspring, or (b) heterozygous and give lobed and not lobed offspring in the proportion of three lobed to one not lobed. (c) Furthermore, parents the leaves of which are not lobed should give only not lobed offspring. Table 2 gives the names of those varieties which are homozygous, that is, upon selfing they produce only lobed seedlings (see, fig. 2). These varieties may be considered as LL in genetic constitution and should behave as such in all subsequent experiments.

TABLE 2

Selfed varieties giving only lobed seedlings

PARENT VARIETY	CONDITION OF LEAF	NUMBER OF SEEDLINGS LOBED	NUMBER OF SEEDLINGS NOT LOBED
Pink—6.....	lobed	81	0
Orphan.....	lobed	56	0
Unknown—4.....	lobed	17	0
Unknown—7.....	lobed	24	0
Dwarf Pink	lobed	255	0
19 Pink 12396—104..	lobed	149	0

Some varieties with lobed leaves which are heterozygous gave, upon selfing, offspring in the proportion of three lobed to one not lobed. Table 3 gives a list of seedling parents which showed such a segregation.

TABLE 3

Lobed parents giving 3 lobed: 1 not lobed progeny upon selfing

NAME OF PARENT	OFFSPRING		RATIO PER 4	EXPECTED RATIO	DEV. ^a	GOODNESS OF FIT
	Lobed	Not lobed			P. E.	
Medium Yellow.....	205	73	2.95 to 1.05	3 to 1	0.7 ^b	Very good
Pink—14.....	182	71	2.88 to 1.12	3 to 1	1.7	Very good
Pink—10.....	243	114	2.72 to 1.28	3 to 1	4.7	Poor
(H. S.×N. R.).....	16	5	3.05 to 0.95	3 to 1	0.2	Very good
Native Red Single.....	4	2	2.67 to 1.33	3 to 1	0.7	Very good
(N. R.×H. S.)—4.....	34	11	3.02 to 0.98	3 to 1	0.1	Very good
Morning Lilac.....	239	107	2.76 to 1.24	3 to 1	3.8	Poor

^a The formula used in determining probable error (P. E.) is $P.E. = 0.6745 \sqrt{\frac{pq}{n}}$ which for a 3 to 1 ratio is $= \sqrt{\frac{1.3647}{n}}$. Barlow's Tables of Squares, Cubes, Square Roots, etc. were used in determining square roots of numbers.

^b If $\frac{Dev.}{P.E.}$ is less than 3, the ratio obtained fits the theoretical 3 to 1 ratio in a significant manner.

For purposes of comparison the writer calculated the ratio per 4 in the results of Mendel's experiments which resulted in the discovery of the 3 to 1 ratio (Mendel, 1909). Table 4 contains the results of the calculations.

TABLE 4

Ratios obtained by Mendel, re-calculated per 4

EXPERIMENT	RATIO PER 4 OBTAINED
Experiment 1	2.99 to 1.01
Experiment 2	3.01 to 0.99
Experiment 3	3.04 to 0.96
Experiment 4	2.99 to 1.01
Experiment 5	2.95 to 1.05
Experiment 6	3.04 to 0.96
Experiment 7	2.96 to 1.04

It will be seen both from the goodness of fit obtained, and from a comparison of the present results with those of Mendel, that the supposition that presence or absence of lobes is due only to one pair of factors is correct, except in the case of varieties Pink-10 and Morning Lilac. It may be argued with reference to table 2, that if three pairs of factors were involved, offspring less than 64 in number, or if 4 pairs of factors, offspring less than 256,

can not include, with ordinary probability, any homozygous recessive individual. However, that really only one pair of factors is involved, is shown not only by the results in table 3 but also by the fact that the segregation shown in this table was observed in nearly all cases where it was expected, among even fewer than 15 offspring arising from individual pods. Table 5 makes this point clear.

Selfed varieties giving only not-lobed seedlings. Unlike the varieties listed in table 2, those named in table 6 gave, upon self-pollination, only unlobed offspring and hence are in the nature of *ll*, or homozygous recessives. No unlobed parent has ever been found to produce other than unlobed offspring, just as would be expected if the *ll* assumption for homozygous recessive is correct.



Fig. 3.—Offspring of a cross between variety 19 Pink 12396-104 (*LL*) and Almost White (*ll*). Seedlings Nos. 3743 to 3762. Note that all individuals are lobed.

Evidences from the results of cross pollination. The truth of the assumption that varieties listed in table 2 have the formula *LL*, those in table 3, *Ll*, and those in table 6, *ll*, is further supported by the results of crosses, such as are indicated below.

(a) $LL \times LL$ should give 100 per cent lobed seedlings. The results of such a cross are shown in table 7.

(b) $LL \times Ll$ should give 100 per cent lobed seedlings. *LL* varieties are given in table 2 and *Ll* varieties in table 3. The results of the crosses ($LL \times Ll$) are shown in table 8.

(c) $LL \times ll$ should give 100 per cent lobed seedlings. The results of these crosses are shown in table 9 (see fig. 3.).

(d) $Ll \times Ll$ should give a ratio of 3 lobed to 1 not lobed seedlings. (See table 10 and, fig. 4.)

(e) $Ll \times ll$ should give a ratio of 1 lobed to 1 not lobed. (See table 11 and fig. 5.)

(f) $ll \times ll$ should give 100 per cent not lobed seedlings. (See table 12 and fig. 6.)



Fig. 4.—Offspring of a cross between Ll varieties, Medium Yellow and Unknown-3. Note the segregation of these offspring into a 3 to 1 ratio. The seedlings are numbered 4452 to 4477.

TABLE 5

Segregation of offspring from individual parent pods

POD	MEDIUM YELLOW		PINK—14		PINK—10		MORNING LILAC	
	Lobed	Not lobed	Lobed	Not lobed	Lobed	Not lobed	Lobed	Not lobed
1	3	4	2	3	2	1	4	2
2	4	2	11	2	6	3	5	0
3	11	0	19	2	3	4	3	2
4	32 ^a	13	12	7	6	1	5	1
5	143 ^a	49 ^a	15	1	6	0	3	4
6	12	5	18	4	6	1	3	3
7			13	18	2	2	4	2
8			57 ^a	29 ^a	13	7	5	2
9			17	5	21	4	5	2
10			18	0	17	5	2	5
11					71 ^a	37 ^a	5	1
12					13	16	8	2
13					58 ^a	26 ^a	5	2
14					14	5	3	2
15					5	2	2	7
16							2	5
17							2	3
18							1	3
19							10	5
20							4	2
21							28	7
22							43	11
23							19	8
24							14	5
25							11	8
26							3	2
27							18	4
28							22	7
Total	205	73	182	71	243	114	239	107

^a From two or more pods.

TABLE 5a

Segregation of offspring from individual parent pods

POD	(H.S. × N.R.)		NATIVE RED SINGLE		(N.R. × H.S.)—4	
	Lobed	Not lobed	Lobed	Not lobed	Lobed	Not lobed
1	5	1	4	2	3	1
2	3	2			17	5
3	3	1			14	5
4	5	1				
Total	16	5	4	2	34	11

TABLE 6

Selfed varieties giving only unlobed seedlings

VARIETY		NUMBER OF SEEDLINGS PRODUCED	
Name	Conditions of leaf	Number of seedlings lobed	Number of seedlings not lobed
Almost White.....	not lobed	0	118
(Pink × Araña)—4.....	not lobed	0	35
Two Days.....	not lobed	0	53
(P. × A.) F ₂ —9.....	not lobed	0	184
Pink—1.....	not lobed	0	110

TABLE 7

Results of crosses between LL varieties

PARENTS		OFFSPRING	
LL	LL	Lobed	Not lobed
Pink—6 × Dwarf Pink.....		46	0

TABLE 8

Results of crosses between supposedly LL and Ll varieties

PARENTS		OFFSPRING	
LL	Ll	Lobed	Not lobed
Pink—6	× Pink—10	105	0
19 Pink 12396—104	× Pink—10	20	0
Dwarf Pink	× Pink—10	24	0
Orphan	× Pink—10	6	0
Dwarf Pink	× Pink—14	27	0
Orphan	× Native Red Single	58	0
Unknown—7	× Native Red Single	19	0
Unknown—4	× Native Red Single	7	0
Dwarf Pink	× Medium Yellow	39	0
Dwarf Pink	× Morning Lilac	63	0
Ll	LL		
Pink—10	× Dwarf Pink	29	0
Medium Yellow	× Dwarf Pink	31	0
Pink—14	× Dwarf Pink	19	0
Native Red Single	× Orphan	24	0
Morning Lilac	× Dwarf Pink	46	0

TABLE 9

F₁ offspring of crosses between varieties of the formula LL and those of the formula ll

PARENTS		OFFSPRING	
LL	ll	Number of seedlings lobed	Number of seedlings not lobed
Dwarf Pink	× (P.×A.) F ₂ —9	34	0
Dwarf Pink	× Two Days	3	0
19 Pink 12396—104	× Almost White	41	0
19 Pink 12396—104	× Pink—1	71	0

TABLE 10

Offspring of crosses between LL varieties

CROSSES	OFFSPRING		RATIO PER 4	EXPECT- ED RATIO	DEV. P. E.	GOODNESS OF FIT
	Lobed	Not lobed				
(N.R.×H.S.)—4 × Pink—10	36	21	2.53 to 1.47	3 to 1	3.1	Fair
Medium Yellow × Pink—10	76	29	2.90 to 1.10	3 to 1	0.9	Very good
Pink—14 × Medium Yellow	31	7	3.26 to 0.74	3 to 1	0.7	Very good
Native Red Single × Pink—10	28	14	2.67 to 1.33	3 to 1	1.8	Good
Pink—14 × Pink—10	42	11	3.17 to 0.83	3 to 1	1.1	Good
Medium Yellow×Morning Lilac	71	25	2.96 to 1.04	3 to 1	0.3	Very good
Morning Lilac×Pink—10	45	3	3.75 to 0.25	3 to 1	4.5	Very poor

TABLE 11

Offspring of crosses between Ll and ll parents

	OFFSPRING		RATIO PER 4	EXPECT- ED RATIO	DEV. P. E. ^a	GOODNESS OF FIT
	Lobed	Not lobed				
Two Days × Pink—10	3	4	0.86 to 1.14	1 to 1	0.6	Very good
Pink—1 × Pink—10	13	8	1.24 to 0.76	1 to 1	1.6	Good
(P.×A.) F ₂ —9 × Pink—10	26	19	1.15 to 0.85	1 to 1	1.5	Good
(P.×A.) F ₂ —9×Medium Yellow	28	9	1.51 to 0.49	1 to 1	4.6	Poor
Medium Yellow×Almost White	19	25	0.86 to 1.14	1 to 1	1.4	Good
(P.×A.) F ₂ —9×Morning Lilac	1	2	1.33 to 0.67	1 to 1	0.8	Good

^a In determining the probable error for the 1 to 1 ratio, the formula used is,

$$P. E. = 0.6745 \sqrt{\frac{pq}{n}} = \sqrt{\frac{0.4549}{n}}$$

TABLE 12

Results of crosses among supposedly homozygous recessive (ll) parents

PARENTS		NUMBER OF SEEDLINGS	
ll	ll	Lobed	Not lobed
Almost White	Unknown—1	0	23
(P.×A.) F ₂ —9	Unknown—1	0	52
Unknown—1	(P.×A.) F ₂ —9	0	6
Unknown—1	Almost White	0	17

Unknown-1 is self-sterile, so it is impossible to determine its genetic constitution by selfing. That it is ll (homozygous recessive) for lobing is proved indirectly by the results of crosses, not only such as are reported in table 12, but also those in table 13.

TABLE 13

Results of crosses between Unknown—1 and other varieties proving that Unknown—1 is of the formula ll

NAME OF VARIETY WITH WHICH UNKNOWN—1 WAS CROSSED	FORMULA OF THIS VARIETY	ACTUAL RESULTS		EXPECTED RESULTS	
		Lobed	Not lobed	Lobed	Not lobed
Native Red Single.....	Ll	7	4	1	1
19 Pink 12396—104.....	LL	42	0	all	0
Medium Yellow.....	Ll	61	58	1	1
Pink—10.....	Ll	4	7	1	1
Dwarf Pink.....	LL	30	0	all	0
Morning Lilac.....	Ll	12	10	1	1

DISCUSSION OF RESULTS

Lobing due to L factor. It has been shown that the results of both self- and cross-pollination of different varieties of *Hibiscus rosa-sinensis* support the assumption that lobing of juvenile leaves is a single Mendelian dominant over absence of lobes. The exceptions to this generalization are the results of self-fertilizing varieties Pink-10 and Morning Lilac, both of the Ll constitution, and of the cross between these same two varieties.

A 2:1 ratio. As table 3 shows, Pink-10 gave, upon selfing, 243 lobed and 114 unlobed offspring, while Morning Lilac gave 239 lobed and 107 unlobed offspring. Crosses between these two varieties and other varieties of the Ll or LL or ll constitution, gave normal results, that is, they proved that Pink-10 and Morning Lilac are simple heterozygotes. However, when

Pink-10 and Morning Lilac were crossed, the offspring were in the ratio of 45 lobes to 3 not lobed, as against the expected 36 lobed and 12 not lobed on the basis of 3:1 ratio. In other words, Pink-10 and Morning Lilac are of the nature of *Ll* when crossed with other varieties, but they behaved in an unexpected manner when self-fertilized or when crossed together. When self-fertilized, both gave a ratio approaching 2:1. It is impossible at present to offer any explanation for these exceptional results. A 2:1 ratio, of course, suggests the presence of a lethal factor in linkage with the dominant factor *L*, and which might cause death in duplex dose. That this is not the case with the results under discussion is indicated by the results of crossing Pink-10 and Morning Lilac. If the lethal factor explanation were correct, the cross also should give a 2:1 ratio. Instead, the ratio obtained was 45:3. Further experiments alone will furnish the true explanation of these unexpected results.



Fig. 5.—Offspring of a cross between variety (P. X A.) F₂-9 (an *ll* variety) and Pink-10, (an *Ll* variety.) Notice the segregation of the offspring into 1 to 1 ratio. These seedlings bear the pedigree numbers 4801 to 4824.

EXISTENCE OF DIFFERENT GENETIC STRAINS OF LOBED VARIETIES AND DOMINANCE OF LOBING OF ONE STRAIN OVER THAT OF ANOTHER

Existence of different strains of lobed varieties. An attempt was made in this study to determine if different lobed varieties have the same degree of lobing. Only varieties Pink-6 and Dwarf Pink were used. It will be recalled that both of these are homozygous (*LL*) with respect to lobing. The degree of lobing is expressed in the form of leaf factor, as given by Leake (1911). The formula for this leaf factor is $\frac{a-b}{c}$, in which *a* is the distance from the tip of the principal or longest lobe to its base, *b*, the distance from

this base to the bottom of the sinus, and c the greatest width of the same lobe. The leaf factor of each plant was obtained by getting the average leaf factor of the first five fully opened leaves of the plant, counting from the top.

In the case of variety Pink-6, 78 F_1 plants, obtained by self-fertilization, were used. As shown in table 14, these 78 plants were of different ages. It is clear from the results, however, that the age did not affect the leaf factor, plants 124 days old had about the same leaf factor as those 196 days old. The same is true with respect to the variety Dwarf Pink. Tables 14 and 15 give the leaf factor for Pink-6 as 3.1 ± 0.08 and for Dwarf Pink, 4.9 ± 0.06 . These results prove that these two varieties, while both are lobed, are different with respect to the degree of lobing, when this is expressed in the form of Leake's factor.



Fig. 6.—Offspring of a cross between two ll varieties, Almost White and Unknown-1. Note that all the seedlings are unlobed.

Lobing of variety Dwarf Pink dominant over that of variety Pink-6. It will be recalled that a cross between these two varieties gave all lobed F_1 offspring, as would be expected from a cross between two LL varieties (see table 7). As shown in table 17, the F_1 plants had the same leaf factor as the variety Dwarf Pink, which happens to have a higher leaf factor than variety Pink-6. This result is different from that found in cotton by Allard (1910) and Leake (1911). Both of these investigators found that the F_1 plants were intermediate in leaf factor between the parents, showing the existence of imperfect dominance. Leake found a suggestion of an F_2 1: 2: 1 ratio as would be expected in a case of imperfect simple dominance. It should be added that in the case of the results of the present work in *Hibiscus*, the F_1 was as uniform as either of the two parents.

TABLE 14

Frequency distribution of leaf factor of (Pink—6). F_1 seedlings

PEDIGREE NUMBER	627-653	1314-1322	1729-1746	2217-2223	2303-2314	4269-4289	ALL
Age in days	196	186	180	164	164	124	
V	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>	<i>f</i>
0.7	1						1
1.2	2		2			2	6
1.7	2		1			1	4
2.2	3	1	3			4	11
2.7	5	1	2	1	3	3	15
3.2	6	2	1	1	1	3	14
3.7	2	2	3	1	1	0	9
4.2	1	1	1	2	3	0	8
4.7	3		0	1	1	2	7
5.2			2	0			2
5.7				1			1
N	25	7	15	7	9	15	78
Mean and P. E.	2.9 ±0.14	3.2 ±0.16	3.1 ±0.22	4.0 ±0.23	3.5 ±0.17	2.7 ±0.18	3.1 ±0.08
Standard deviation and P. E.	1.07 ±0.10	0.63 ±0.11	1.24 ±0.15	0.92 ±0.17	0.74 ±0.12	1.01 ±0.12	1.09 ±0.06
Coefficient of variability and P. E.	36.89 ±3.98%	19.69 ±3.69%	40.00 ±5.66%	23.00 ±4.31%	21.14 ±3.49%	37.41 ±5.21%	35.16 ±2.13%

TABLE 15

tion of leaf factors of (Dwarf Pink) F_1 seedlings

4227-4228	4302-4312	4409-4427	4428-4444	2121-2135	1375-1378	2112-2120	2042-2056	3585-3600	2058-2068	2069-2080	2087-2095	ALL
134	155	185	161	158	202	156	191	155	184	189	156	
f	f	f	f	f	f	f	f	f	f	f	f	f
1	1	1	1	3	1	1	1	1	2	1	1	3
0	1	2	0	4	1	3	2	0	2	0	0	3
0	1	2	0	2	1	1	3	1	1	0	0	7
0	0	6	4	2	0	1	4	3	0	1	1	19
1	4	1	1	3	1	2	0	1	3	1	1	21
	2	5	3	3	1	2	2	4	2	1	0	39
		2	5	1	1	2	3	1	1	1	0	34
			1	3	1	1	0	4	2	2	1	40
			1	5	1	2	2	1	1	1	0	25
			1	1	1	3	3	1	1	1	1	25
										4	4	15
										1	1	2
												3
												0
												0
												0
												0
												1
2	8	19	16	14	4	9	15	16	10	11	8	238
3.3	4.1	5.4	6.1	4.6	5.2	5.2	5.4	5.1	3.9	5.1	6.2	4.9
± 0.48	± 0.16	± 0.11	± 0.7	± 0.13	± 0.27	± 0.16	± 0.17	± 0.16	± 0.19	± 0.22	± 0.22	± 0.06
1.00	0.66	0.72	1.02	0.73	0.79	0.69	0.96	0.94	0.87	1.06	0.93	1.27
± 0.34	± 0.11	± 0.08	± 0.12	± 0.09	± 0.19	± 0.11	± 0.12	± 0.11	± 0.13	± 0.15	± 0.16	± 0.04
30.30	16.10	13.33	16.72	15.86	15.20	13.27	17.78	18.4	22.31	20.78	15.0	25.92
$\pm 5.57\%$	$\pm 2.76\%$	$\pm 1.49\%$	$\pm 2.03\%$	$\pm 2.07\%$	$\pm 3.70\%$	$\pm 2.14\%$	$\pm 2.24\%$	$\pm 2.27\%$	$\pm 3.53\%$	$\pm 3.10\%$	$\pm 2.58\%$	$\pm 0.85\%$

PEDIGREE NUMBER	1203-1207	1379-1394	1424-1439	1512-1516	1850-1863	2021-2041	2096-2111	3193-3209	3579-3584	4201-4205
Age in days	206	185	185	203	187	186	183	164	150	138
V.	f	f	f	f	f	f	f	f	f	f
1.7		1		1		1				
2.2		1		1		1				
2.7		1		0		0				
3.2	1	1		0		0				
3.7	2	5	1	2	2	1	2	1		1
4.2	1	1	2	2	1	3	1	3		0
4.7	1	1	3	1	3	1	1	3		0
5.2		2	4	1	1	3	2	3	1	2
5.7		4	2	1	1	3	4	1	1	1
6.2			0	1	1	2	2	2	2	2
6.7			2		2		2	3	1	
7.2					0		0	0		
7.7					0		0	0		
8.2					1		1	1		
8.7							0			
9.2							0			
9.7							0			
10.2							0			
10.7							1			
N	5	16	14	8	12	9	16	17	6	3
Mean and P. E.	3.4 ±0.15	5.3 ±0.19	4.6 ±0.16	3.8 ±0.24	4.9 ±0.26	3.9 ±0.21	5.4 ±0.20	4.9 ±0.19	5.3 ±0.18	3.7 ±0.27
Standard deviation and P. E.	0.51 ±0.11	1.11 ±0.13	0.86 ±0.11	1.01 ±0.17	1.31 ±0.18	0.94 ±0.15	1.77 ±0.21	1.14 ±0.13	0.67 ±0.13	0.71 ±0.20
Coefficient of variability and P. E.	15.00 ±3.26%	20.89 ±2.60%	18.70 ±2.47%	26.58 ±4.79%	26.73 ±3.82%	24.10 ±4.10%	32.77 ±4.31%	23.27 ±2.82%	12.64 ±2.48%	19.18 ±5.43%

TABLE 16

Frequency distribution of leaf factor of (Pink-6 × Dwarf Pink)
F₁ seedlings

PEDIGREE NUMBER		1765-1783	2196-2226	ALL
Age in days		185	174	
V		f	f	f
2.2		1		1
2.7		1		1
3.2		2	1	3
3.7		1	0	1
4.2		3	8	11
4.7		3	3	6
5.2		2	7	9
5.7		1	7	8
6.2		0	2	2
6.7		1	2	3
7.2			1	1
N		15	31	46
Mean and P. E.		4.3 ±0.20	5.2 ±0.11	4.9 ±0.10
Standard deviation and P. E.		1.17 ±0.14	0.89 ±0.08	1.06 ±0.07
Coefficient of variability and P. E.		27.44 ±3.62%	17.11 ±1.50%	21.63 ±1.58%

TABLE 17
Frequency distribution and constants of leaf factor of parent Hibiscus varieties Pink-6 and Dwarf Pink and of a F₁ cross between them

VARIETY	FEMALE PARENT (PINK-6) F ₁	MALE PARENT (DWARF PINK) F ₁	CROSS (PINK-6 × DWARF PINK) F ₁
V	f	f	f
0.7	1		
1.2	6	3	1
1.7	4	3	1
2.2	11	7	3
2.7	15		11
3.2	14	19	6
3.7	9	21	9
4.2	8	39	8
4.7	7	34	2
5.2	2	40	25
5.7	1	25	25
6.2		15	3
6.7		2	1
7.2		3	
7.7		0	
8.2		0	
8.7		1	
9.2		0	
9.7		0	
10.2		0	
10.7		1	
N	78	238	46
Mean and P. E.	3.1 ±0.08	4.9 ±0.06	4.9 ±0.10
Standard deviation and P. E.	1.09 ±0.06	1.27 ±0.04	1.06 ±0.07
Coefficient of variability and P. E.	35.16 ±2.12%	25.92 ±0.85%	21.63 ±1.58%

ABSENCE OF LOBES IN JUVENILE LEAVES HIGHLY CORRELATED WITH SELF-STERILITY, OR SELF-INCOMPATIBILITY.

At the close of the pollination experiments reported, in part, in this paper, it became evident that there is a positive correlation between self-sterility, or self-incompatibility, and absence of lobes in juvenile leaves of *Hibiscus rosa-sinensis*, and a negative correlation between presence of lobes and these forms of inability to self-reproduce. It will not be surprising if it be found later that the factor for self-sterility, or self-incompatibility, is linked with that for absence of lobes, and the factor for self-fertility, with that for the presence of lobes.

That the correlation mentioned above exists is shown in table 18 which gives the arrangement of the varieties with respect to the characters involved and by the coefficient of correlation obtained from this arrangement.

TABLE 18
Arrangement of varieties of H. rosa-sinensis according to sterility, fertility, and as to lobing and not lobing

VARIETIES	SELF-FERTILE	SELF-STERILE OR INCOMPATIBLE
Lobed	(a) 19	(b) 2
Not lobed	(c) 6	(d) 20

According to Yule's formula, $r = \frac{ad-bc}{ad+bc}$. Applying this formula to the data in table 14, r is determined as $\frac{19 \times 20 - 2 \times 6}{19 \times 20 + 2 \times 6}$ or $r = 0.94$. This is almost perfect, for, according to this formula, $r = 1$ when correlation is perfect, and $r = 0$ when there is no correlation. The existence of such a high coefficient of correlation between the characters under study suggests linkage of the factors representing these characters, and the fact that the correlation was not perfect also suggests crossing-over between the factors of one linkage group with those of the other.

The seedlings reported in this study began flowering on April 27, 1925, and since then, they are being tested for self-fertility and self-sterility. The results of this part of the research will throw much light on these suggestions and will be reported in due time.

SUMMARY

1. The results of the experiments reported herewith proved that the presence of lobes in juvenile leaves of *Hibiscus rosa-sinensis* is a simple dominant over absence of lobes.
2. These studies involved thirteen lobed and six not-lobed parent varieties, and a total of 3964 seedlings.
3. Conclusion No. 1 is derived from the results of both self-and cross-artificial pollinations performed almost every day from September 18, 1924,

to March 3, 1925, the observations on presence or absence of lobes terminating on June 15, 1925.

4. Evidence is presented showing the existence of correlation between self-sterility, or self-incompatibility, and unlobed juvenile leaves, and between self-fertility and lobed leaves. This evidence suggests the existence of linkage between the recessive factor *l* and the factor for self-sterility, or self-incompatibility, if any such factor be in existence, and the dominant factor *L* and that for self-fertility. There was also a suggestion that if such linkage exists, there is crossing over between certain factors involved.

5. Two varieties, which behaved as simple heterozygotes when crossed with others, gave a 2:1 ratio upon self-fertilization and 45:3 ratio upon crossing together.

6. Evidence was obtained showing the existence of different genetic strains of lobed varieties and perfect dominance of one degree of lobing over another.

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STUDIES ON THE FERTILITY OF THE HEN'S EGG¹

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Being able to produce eggs that will hatch into vigorous chicks sometimes decides the success or failure of a poultry breeder. Failure to produce such eggs may mean a year of disappointment or even failure in the business of poultry raising.

It is a thing to be regretted that, as a general rule, it is the hens that receive the lion's share of the poultryman's attentions. The rooster which is really one half of the flock and which should be the better half, is most of the time left to shift for himself. To say that fifty per cent of the number and quality of chicks produced and raised to maturity in a breeding season depends upon the vigor and health of one or a few roosters is not an exaggerated statement. As it is the rooster that regulates the fertility of the eggs laid by the flock of which he is the head, to keep him in excellent breeding condition, that is active and fertile, should engage the attention of the poultrymen.

One of the many phases of this many-sided question is the regulation of the number of times a rooster should mate in a day. A White Leghorn rooster allowed to run among White Leghorn hens after having been separated for some time has been observed to mate as many as thirty-eight times in a day (Philips, 1918). Martin and Anderson (1918), however, reported that of thirty-four White Leghorn hens served by one male in one day, only ten laid fertile eggs, one did not lay, and twenty-three laid no fertile eggs. From these observations, it appears that a great many of the matings in most cases were unnecessary, and these also had the bad effect of lowering the rooster's vitality. Continuous service among stallions has shown that the number of sperms decreased considerably in the later matings (Lewis, 1911). Similar observations were reported by Lode (1891) among men, and in the dog he found that the number of sperms was greater at the end of an interval in which there were no emissions. Lloyd-Jones and Hays (1918) observed that excessive sexual activity among rabbits reduced not only the number of spermatozoa produced, but also their motility. With chickens, it has been observed that roosters that are regularly active, sexually, produce a higher percentage of dead or weak sperms than those that are less active (Craft et al, 1926).

With respect to the general fertility of the eggs, Waite (1911), Philips (1918), and Martin and Anderson (1918) reported that among White Leg-

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horns, if a rooster is allowed to run with the hens after having been separated from them for some time, the fertility of the eggs obtained during the first day was generally poor. However, these investigators observed that beginning the second or third day after mating, the fertility was excellent on through the first week or more. Lippincott (1921) reported unpublished data of Bittenbender at Iowa State College and of Sherwood of the Ohio Experiment Station, which practically corroborated the results of the above named investigators. From common experience and in the light of these observations, Lippincott concluded that "it seems safe to state that in practice it will be found that eggs laid by vigorous hens will usually be fairly fertile in six days in the case of Mediterranean breeds, and in eight to ten days in the case of the American breeds, while two weeks is necessary in the case of pullets, assuming in each case that the male is vigorous and active".

The object of the present study was to determine what influence a regulated mating would have upon the fertility of eggs produced by Cantonese pullets. This paper reports the first of a series of observations that are being carried on in the Department of Animal Husbandry of this College in the mating habits of fowls. The problem under discussion now has a very practical application in stud-mating of fowls for specialized breeding operations. The data presented in this paper are in answer to the questions, how soon, under regulated mating, could fertile eggs be expected, and how long will this fertility last?

MATERIALS

The birds used in this study consisted of a flock of young Cantonese pullets that had been laying about a month prior to the beginning of the experiment. No rooster had been running with these pullets, previously. They were divided into three pens of twenty birds each. In each pen was a mating cage where a healthy, vigorous Cantonese rooster was confined. The pullets, as well as the roosters used, were given normal laying rations. Special care was exercised in the feeding of the roosters so that their breeding abilities would not be impaired by their continuous confinement. They were fed at the same time as the hens, but in addition to this, a piece of sod about twenty centimeters square was placed in the mating cages every day at noon to furnish green feed. Clean, fresh water was available to the birds at all times. The experiment lasted from September 1 to November 1, 1925, a period covering two months.

The careful feeding of the roosters in the cages was to prevent any bad effect of under-feeding or poor nourishment upon them. Craft, McElroy, and Penquite (1926) in their study of the influence of certain feeds upon the production of spermatozoa by the domestic chicken found that males given the most deficient rations produced fewer sperms on the average than those on more desirable rations.

The pullets used in this study had the freedom of the range; they had all the green feed they needed. The mash feed was placed in bamboo feeding troughs and made available to the birds at all times. Wet mash which consisted of the ground feed moistened with water was given daily about noon. The roosters in the mating cages received their share of this wet mash.

MATING

The birds were mated individually. This was accomplished by putting a pullet into the mating cage soon after laying. For this reason no bird that was not laying was mated. After mating, the pullet was released and not mated again until after the fertility of her eggs laid had ceased. The date and time of mating was recorded. The eggs were gathered regularly at intervals of two hours from six o'clock in the morning to six in the evening. The dates and hours when eggs were laid were also recorded carefully.

INCUBATION

A one-hundred-ten-egg hot water Buckeye incubator was kept running during the period the experiment was in progress. As soon as the eggs were collected, they were placed in the incubator. The eggs were incubated for seven days when they were tested for fertility. Those that appeared infertile or were doubtful were broken into a saucer and examined closely to see if they were fertilized but had died early in the period. Thus "actual" and not "apparent" fertility was determined.

RESULTS

Number and time of matings. All in all, forty-five matings were made. There were a few days when there was no mating, and the greatest number of matings accomplished in one day was only five. The time of the matings depended upon the time of laying of the egg, and for this reason, very few matings were made at noon, as very few eggs are laid about this time of the day. There were no birds mated at six o'clock either in the morning or in the afternoon. Three birds were mated twice as these were able to lay two cycles of eggs during the period covered by the experiment. One bird was mated by mistake before she was through laying her first cycle of eggs; this particular one was discarded in the computation of the length of time when fertility ceased. Two pullets did not lay any egg after mating, and these two were not considered in the presentation of the data. Also no matings from which no fertile eggs were produced were taken into consideration in the figures given in the tables.

TABLE 1

Showing the number of matings made in the different hours of the day

TIME	MATINGS THAT WERE FERTILE	MATINGS THAT WERE INFERTILE	TOTAL MATINGS MADE
6	0	0	0
8	6	2	8
10	10	4	14
12	4	1	5
2	9	1	10
4	7	1	8
6	0	0	0
Totals	36	9	45

It may be seen from this table that not all of the matings produced fertile eggs. When the first five eggs produced after mating were found to be infertile, the plan was to remate the birds. Unfortunately, these birds generally stopped laying before this could be ascertained. A number of these pullets, however, were mated when they laid their second batch of eggs, and these produced, without exception, fertile eggs. The failure of the first services to produce fertile eggs could hardly be attributed to any other cause except imperfect matings, as the same birds that failed to produce fertile eggs showed excellent fertility when they were later mated.

When a rooster and hens are out in the yards together, as a general rule, it is the hen that offers the service to the rooster. Once in a while, the offer is not heeded, but when it is accepted as happens in most cases, the service can rightly be considered as accomplished normally. Under the conditions of this experiment, however, the males were confined. When the pullets were offered for service, the roosters were so anxious that they even tried to cover the hens when these were still in the hands of the attendant. It is very probable, in the absence of other apparent factors that would cause such imperfect matings, that these matings were due to imperfect services occasioned by the rooster's extreme anxiety to cover the hens.

The fertility of the eggs. The results obtained from thirty-six fertile matings are given in table 2.

From this table it appears that quite a number of eggs laid the day after mating may be expected to be fertile, and a fairly good percentage is maintained up to two weeks after mating. Under the conditions of this experiment, three out of the five eggs laid seventeen days after mating were fertile. All of three eggs laid after the seventeenth day were infertile. No

more eggs were laid after the nineteenth day after mating. There were a few infertile eggs laid between the fertile ones. These, however, are not shown in the table.

TABLE 2
Showing the fertility of the eggs laid after mating

DAYS AFTER MATING	EGGS LAID	EGGS FERTILE	PERCENTAGE FERTILE EGGS
1	18	8	44.4
2	23	18	78.3
3	21	18	85.7
4	24	19	79.2
5	16	16	100.0
6	26	18	69.3
7	19	16	84.2
8	19	14	73.7
9	15	12	80.0
10	19	15	79.0
11	9	7	77.8
12	13	8	61.5
13	10	8	80.0
14	10	5	50.0
15	8	5	62.5
16	6	4	66.7
17	5	3	60.0
18	1	0	0
19	2	0	0
20	0	0	0
21	0	0	0
22	0	0	0

The results obtained in this study are similar to those obtained by Waite (1911) among White Leghorns and Rhode Island Reds, by Kaupp (1919) in his tests where he used a composite collection of eggs laid by a flock composed of a group of birds representing the most common breeds of poultry, and the results of Bittenbender and of Sherwood, as reported by Lippincott (1921). However, better percentages of fertility were obtained in this study, due perhaps to the fact that the number of matings was better regulated, the roosters having been confined. Under these same conditions, it seems that only one mating in about a week of laying is all that is necessary in stud-mating poultry for the production of fertile eggs. Therefore the common practice among poultry breeders of mating each hen every time an egg is laid may be considered as excessive mating. Again, these results tend to point out that under conditions similar to those under which this experiment was carried out, a rooster may easily take care of a considerably greater number of hens than is at present considered to be best.

Time elapsing between mating to the laying of the first fertile egg. Data from only thirty-four out of the thirty-six fertile matings are included in table 3.

TABLE 3
*Showing the actual length of time elapsing between mating,
and laying of first fertile egg*

BIRD NO.	TIME THE FIRST FERTILE EGG WAS LAID	TIME INFERTILE EGGS WERE LAID BEFORE FERTILE ONES
	<i>hours</i>	<i>hours</i>
9	46	None laid
16	32	None laid
	42 ^a	None laid
31	22	None laid
	24 ^a	None laid
36	72	44
42	140	46 and 98
45	26	None laid
59	28	None laid
76	68	26
77	114	40 and 66
81	50	26
89	20	None laid
101	30	None laid
109	48	24
117	212	44, 140 and 168
127	78	None laid
132	44	None laid
153	100	50 and 72
161	96	None laid
169	46	None laid
405	54	None laid
439	78	25
	24 ^a	None laid
440	122	28
458	20	None laid
459	46	None laid
463	44	None laid
477	116	24
484	238	68, 94 and 136
485	92	None laid
496	40	None laid
498	28	None laid
532	48	20
Range	20-238	20-168

^a Second mating (after the first cycle of eggs).

The figures given in table 3 show that the actual length of time that elapses from mating to the laying of the first fertile eggs varies from twenty

to two hundred and thirty-eight hours (nine days and twenty-two hours). In fourteen out of the thirty-four matings, infertile eggs were laid before the laying of fertile ones. Martin and Anderson (1918) in their tests with White Leghorns observed that the first fertile egg was laid twenty-nine hours and twenty-three minutes after mating. The results of the work of Townsley as reported by Philips (1918), also with White Leghorns, show only twenty-three hours elapsing after mating to the laying of the first fertile egg. In the present study, two fertile eggs were laid twenty hours, and one at twenty-two, twenty-four, twenty-six, twenty-eight, and thirty hours after mating.

These results give a clue to the actual length of time required for an egg to pass through the entire length of the oviduct. The course taken by the egg from the time it leaves the funnel or infundibulum to the laying is supposed to be as follows: After the yolk leaves the yolk sac, it drops into the funnel. After leaving the funnel, it goes into the glandular portion, also called the albumen secreting portion, of the oviduct where the major portion of the albumen of the egg is received. Investigators agree that the egg stays in this region of the oviduct about three hours (Patterson, 1910; Pearl and Curtis, 1912; and Lillie, 1919). These three investigators differ somewhat in their observations as to the length of time an egg stays in the isthmus. Among Barred Plymouth Rocks, Pearl and Curtis observed that the egg goes through that portion in about thirty-six minutes. Lillie, on the other hand, believes that it takes one hour for the egg to pass through the isthmus and receive the shell membranes and a part of the albumen. Patterson, however, concluded that two to three hours are needed for the egg to pass through that portion. The length of time that the egg stays in the uterus to receive the rest of the albumen and the shell varies from twelve to seventeen hours. In spite of these differences in time distribution, these same investigators agree that it takes about twenty-two hours from ovulation to the actual laying of the egg. It is Patterson's opinion (1910) that the laying of the egg may be lengthened by disturbing the hen when she is about to lay, but in normal cases, to quote this investigator, "any appreciable extension beyond twenty-two hours is not due to an increase of time that it takes the egg to traverse the reproductive passage, but rather to a retention of the egg in the lower part of the oviduct, on account of some influence inhibitory to laying". Some of these influences may be disturbances when the hen is about to lay, fright, time spent by the bird in looking for a suitable place in which to lay, or in the case of pullets just coming to laying, not fully developed uterus and cloaca.

From these results, it appears that it takes only twenty hours from ovulation to the laying of the egg. Patterson (1910) observed that fertilization of the hen's egg occurs in the anterior end of the oviduct, and this occurs immediately after ovulation. Three cases in which eggs were laid twenty hours after mating were observed, and of these three, two were fertile.

These fertile eggs must have been just twenty hours old, otherwise they could not have been fertilized if they had already passed the funnel when the birds were mated. Furthermore, except in rare instances, "so long as there is an egg in the lower part of the reproductive passage, the infundibulum apparently does not clasp the ovum, and a second egg is thus prevented from entering the oviduct." Patterson (1910).

It seems almost inconceivable that the sperms should be able to travel so rapidly, in view of the fact that the organ of copulation of the fowl consists only of a small papilla, the expanded posterior end of the vas deferens. In copulation, this papilla is everted and brought into contact with the similarly everted orifice of the oviduct of the female (Kaupp, 1918). The semen is then ejected, and the spermatozoa which because of their activity due to their motile organ, the tail, are thus conveyed into the oviduct. But that these spermatozoa should be capable of traversing the entire length of the oviduct in less than an hour, or immediately after copulation, is remarkable.

Among the larger mammals, from the results of the work of Lewis (1911) and those of Anderson (1922), it may reasonably be stated that fertilization takes place mostly within twelve hours after insemination, except in rare cases in which it may extend to thirty-six or even forty-eight hours. Anderson's observations with hens which were hand mated and destroyed for observation after periods varying from six to forty-eight hours, showed that "none of the spermatozoa had progressed farther than one third the length of the oviduct." The results obtained in the present study, however, show that the spermatozoa could traverse the entire length of the oviduct immediately after coition. This must have been the case in order that the two fertile eggs could be laid twenty hours after mating. Lott (1871) estimated that spermatozoa move at the rate of only 3.6 millimeters a minute. It is very possible, however, that in the chicken the force of the ejaculation of the seminal fluid containing the spermatozoa is assisted by a strong sucking action of the oviduct thus conveying the spermatozoa right into the funnel. This sucking action of the oviduct as aiding the passage of the spermatozoa into the uterus has been shown by Heape to occur among rabbits (1898).

The considerably longer time that elapsed between mating and the laying of the first fertile egg may have been due to a number of causes. In the first place, there is the actual intensity of the production which varies considerably in different individuals, some being capable of laying an egg every day, while still others lay only every two, three or even more days. In all cases, the spermatozoa traverse the entire length of the oviduct and wait for ovulation right in the funnel, so that when the yolk is released from the yolk sac, the sperms are ready for it. In quite a number of cases, infertile eggs were laid before fertile eggs were produced. Inasmuch as it is possible, but may not necessarily occur with regularity, for the spermatozoa

to reach the infundibulum almost immediately after the mating is accomplished, it may also be possible that the sperms may have been delayed in their movements through the oviduct so that when the yolk dropped into the infundibulum, there were no spermatozoa available for it. Thus the egg moved down through the oviduct in the natural course without having been fertilized. This may have been the case when only one infertile egg was laid before the fertile one, and only in such cases where these infertile eggs were laid between twenty and twenty-six hours after mating. In the cases where more than one infertile egg was laid before fertile ones, actual preferential fertilization may have been one of the principal causes. There may have been either a chemical or a physiological disagreement between the protoplasm of the sperms and that of the germ disc, or certain inhibitory agencies in the ovum have become so active as to exclude the sperms altogether and therefore every possibility of fertilizing it. If there are other causes of this phenomenon, the writer does not know what they are.

Cessation of fertility. The lengths of time elapsing from mating to when the last fertile egg was laid vary considerably. Data from thirty-two matings are given in table 4.

From this table it may be seen that the length of time that elapses from mating to the laying of the last fertile egg varies from fifty-four to four hundred and sixteen hours, or from two days and six hours to seventeen days and eight hours. Among White Leghorns, Philips (1918) reported that the last fertile egg was laid three hundred and fifty-five hours, or fourteen days and nineteen hours after mating. Spallanzani (1784), however, reported that a hen can lay fertile eggs twenty days after mating. The results of Elford (1916) confirm the report by Philips. Among pigeons, Riddle and Behre (1921) found that the sperms retained their fertilizing power for nearly eight days.

The spermatozoa of chickens can live inside the body of the hen over a considerably longer period than those of the hog and stallion, in which cases the vitality of the sperms lasts only a few hours, and at most, in a few instances, about twenty-four hours in the sow and in the mare, respectively (Lewis, 1922). Under laboratory conditions, Anderson (1922) observed that mammalian spermatozoa are active for only about six to eight hours. Among humans, Marshall (1922) cited the observations of Strassman, of Bossi, and of Dührssen who found that human spermatozoa could live in the female generative passages for periods varying from a week to three and a half weeks.

In a number of cases, as may be seen under the last column, "number of infertile eggs laid after," the fertility of the eggs ceased before the entire number of eggs in a particular batch have been produced, but in a majority of these instances, only one mating was necessary to fertilize one batch of eggs. These results furnish a good guide for breeders who practice stud-mating in their breeding operations. Single matings have been sufficient

to fertilize a whole batch of eggs in some cases, but not in others. Among turkeys, it has been reported by Marshall (1922) that only one mating was necessary to fertilize a whole batch of eggs. Similar observations have been reported by the turkey raisers of Añgono, province of Rizal, (Frona, 1925).

TABLE 4
*Showing the time elapsing from mating to the laying of
the last fertile egg*

BIRD NO.	TIME LAST FERTILE EGG WAS LAID	NUMBER OF FERTILE EGGS LAID	NUMBER OF INFERTILE EGGS LAID AFTER
	<i>hours</i>		
9	240	5	0
16	236	7	0
	168 ^a	6	1
31	242	9	0
	124 ^a	5	0
36	54	2	6
42	288	9	0
45	412	12	1
59	310	4	0
76	312	9	1
77	304	8	1
81	416	14	0
89	240	8	0
101	244	6	0
109	244	5	4
117	212	1	3
127	364	5	0
132	218	5	0
153	124	2	1
169	94	2	3
405	102	3	0
439	170	4	0
	388 ^a	12	0
440	340	5	0
458	358	7	1
459	140	2	0
463	264	3	0
477	384	8	0
484	378	4	1
496	308	5	1
498	174	6	0
532	138	1	6
Range	54-416	1-14	0-6

^a Second cycle.

It appears, then, that a mating a week will be all that is necessary in stud-matings to insure a high percentage of fertility of the eggs. This will keep the rooster always in excellent breeding condition and the amount of

time and labor expended in the more frequent individual mating of the birds is reduced considerably. This will also make it possible for a rooster to mate with many more birds than when the hens are mated every day following the general practice among poultry breeders in the United States and perhaps also in other countries.

SUMMARY

1. Infertile eggs were produced from nine out of forty-five matings made.
2. A fair percentage of fertility may be expected in eggs laid one day after mating. In this experiment, the percentage of fertility of the eggs was satisfactory up to the seventeenth day after mating.
3. Two fertile eggs and one infertile were laid twenty hours after mating. The last fertile egg was laid four hundred and sixteen hours, or seventeen days and eight hours after mating.
4. For stud-mating purposes, only one service a week is necessary to produce eggs of sufficiently high fertility.

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RHIZOCTONIA DISEASE OF RICE: I. A STUDY OF THE DISEASE
AND OF THE INFLUENCE OF CERTAIN CONDITIONS UPON
THE VIABILITY OF THE SCLEROTIAL BODIES OF
THE CAUSAL FUNGUS¹

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WITH FOUR PLATES AND THREE TEXT FIGURES

The occurrence of the *Rhizoctonia* disease of rice (*Oryza sativa* L.) in the Philippine Islands was noted in 1917 and a year later the disease was briefly described by Reinking (1918). From 1917 to 1920 many inoculations on rice and on various economic plants including weeds were conducted by Mr. G. O. Ocfemia. This work was a part of the "Study of Philippine rice fungi with special reference to those which cause disease" which was suggested to Mr. Ocfemia by Professor C. F. Baker, Dean of the College of Agriculture. Except for an incomplete work on the relation of soil temperature to the infection of rice seedlings by *Rhizoctonia* and *Sclerotium* conducted by Mr. Ocfemia in 1921 and 1922 at the University of Wisconsin, no further work was done at this College on the disease until the latter part of 1924.

In October, 1924, the writer collected blighted rice seedlings on the College Farm at Los Baños and placed these in the damp chamber. After a few days the seedlings began to turn yellow and die and on the leaves and stems of the dead plants sclerotial bodies of *Rhizoctonia* were formed in great abundance.

The fungus grows very rapidly on the rice in the damp chamber, and in the field when the weather is moist and warm and where the plants are thickly planted.

THE DISEASE

Hosts

Rhizoctonia is a common soil-inhabiting fungus. If plants are planted rather thickly in a *Rhizoctonia*-infected field the fungus is capable of doing much damage, especially during moist weather. *Rhizoctonia* attacks a large

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² The writer is indebted to Dr. G. O. Ocfemia of the Department of Plant Pathology for data obtained in work done by him in 1917-1920 and for suggestions during the course of this work and in the preparation of the manuscript.

variety of hosts representing many families, the greater number being dicots. A number of monocots and several Gymnosperms are also infected. In the Philippines, *Rhizoctonia* attacks legumes (*Phaseolus* spp., *Stizolobium deeringiana* Bort. *Mucuna deeringiana* Merr. etc.), causing blight. In association with *Pythium debaryanum* Hesse and *Sclerotium rolfsii* Sacc., *Rhizoctonia* often causes damping-off of seedlings of many plants in seed beds. Peltier (1916) in the United States lists about 165 species of plants susceptible to *Rhizoctonia solani* Kühn. The list includes floricultural plants, vegetables, field crops, herbaceous plants, and weeds. Investigators believe that many more hosts of *Rhizoctonia* will be discovered from time to time in different countries.

Distribution

Species of the genus *Rhizoctonia* are found all over the world as saprophytes. Under certain conditions, however, they become aggressive parasites. Diseases caused by species of this genus have been reported from almost all countries of Europe, Canada, the United States, South America, West Indies, India, Australia, and the Philippines. It is found in all climes ranging from the hot tropical countries to the cool temperate regions. In the Philippines a species of *Rhizoctonia* seems to be very common and it kills many plants in propagating beds and in the field.

Importance

Rice is one of the few monocots attacked by *Rhizoctonia* in the Philippines. In field observations made by Mr. G. O. Ocfemia in rice fields of the College of Agriculture in 1918 and 1919, an entire paddy from which water was drained was so seriously infected with *Rhizoctonia* that many of the plants died when they were in the seedling stage and others were killed before the kernels on the panicles began to fill. In another field where rice was drilled in rows 50-75 centimeters apart the plants were badly damaged. Actual counts showed that from 25 to 50 per cent of the plants were killed by the disease. When rice was planted farther apart or drilled in rows 50-75 centimeters apart, however, many of the fast-growing plants recovered, especially if only the older leaves and leaf sheaths were infected. Under field conditions the disease spreads very rapidly through the contact of leaves of rice with the soil and infected leaves of rice and of weeds.

Symptoms

The symptoms of *Rhizoctonia* infection are the presence of blotches with grayish green, bluish-gray, or straw colored centers and distinct brown borders on leaves and leaf sheaths (see *l* and *sh* in plate I). These spots are very distinct even after the death of the infected rice. The spots are usually elliptical to oblong when young but become large and more or less irregular when several of them coalesce. Droplets of yellowish brown liquid collect

on the surface of the lesions during moist weather. If conditions are favorable, the fungus continues to develop until the whole plant is killed. If the plant is severely attacked, most or all of its outer leaves are killed and subsequently fall over.

The symptoms caused by *Rhizoctonia* differ from those brought about by *Sclerotium*, another sclerotia-producing soil fungus, in that *Rhizoctonia* produces discolored spots with distinct borders and *Sclerotium* does not. Pereira (1922) states that *Sclerotium* induces the production of late tillers and poorly developed and partly sterile panicles. In advanced cases of *Sclerotium* infection the sheaths and culms at the bases of stools may be readily broken to pieces due to the dry rot which ensues. Masses of white mycelium in the tissues may also be exposed. Although dwarfing and partial sterility of the panicles are produced by *Rhizoctonia* (plate II) dry rot, shredding of the straw, and the presence of masses of white mycelium do not occur as in *Sclerotium* infection.

Rhizoctonia attacks the base, outer leaf sheath, and the leaves of both mature and seedling rice. Infection may come from the fungus on the ground or by the rice coming in contact with other plants as beans (*Phaseolus* spp.) or weeds which are infected. Early in the morning during the wet season the aërial hyphæ on infected plants in the field and artificially inoculated plants in damp chambers (plates III and IV) may be as long as three to five centimeters.

The parts of the rice above the infected regions finally become yellow. Saprophytic fungi and bacteria work together with the *Rhizoctonia* in advanced stages and cause a rapid decay of the stems and leaves. On the decaying parts of the plants, webs of brownish silky mycelium are formed (plates III and IV). Sclerotial bodies, at first white, but which gradually turn brown, are formed superficially on the decaying parts of the plant. In the absence of an abundance of moisture, the growth of the fungus is either partially or totally checked. If this condition prevails the development of sclerotial bodies does not take place although the fungus has a luxuriant growth of mycelium at the beginning. The sclerotial bodies are at first connected with one another by means of threads of mycelium, but later the hyphæ are broken and the sclerotial bodies then drop from the host to the soil. In the ground, on account of their shape and color, these sclerotial bodies can hardly be distinguished from the soil particles and debris. In the soil they remain alive and are sources of infection from season to season.

If infected rice tissues are teased apart and examined under the microscope, brownish, branched, and closely septate mycelium of *Rhizoctonia* may be seen in abundance.

CAUSAL ORGANISM

The fungus used in the present work was isolated from the sclerotial bodies which were found on rice seedlings. They were disinfected with mercuric chloride (1:1000) for two minutes and then plated out on potato-dextrose agar. From the mycelium which developed from the sclerotial bodies, subcultures were made on different media and sterilized plant tissues for observation of the cultural behavior.

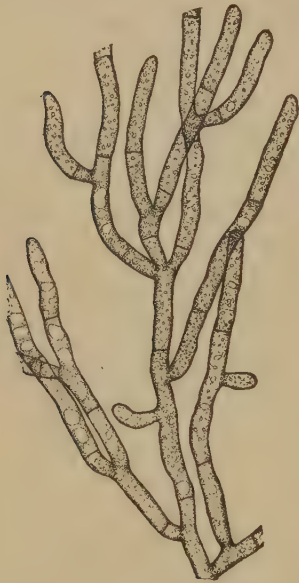


Fig. 1.—A young submerged hypha of the *Rhizoctonia* on rice showing the mode of branching and the very granular cytoplasm of the cells. $\times$ about 230.

MORPHOLOGY

Imperfect or sterile stage: (a) *Mycelium.* *Rhizoctonia* may be readily distinguished from other fungi by certain characteristics of the mycelium. In pure culture the hyphæ are either aërial or submerged. The submerged hyphæ remain colorless as long as there is a good supply of nourishment from the plant tissues or substrate.

A distinctive manner of branching is exhibited by young hyphæ growing in pure culture (fig. 1)³ or in diseased tissues. The young branches arise from the parent hyphæ generally at acute angles. Subsequently, they bend to the direction of growth of the parent branches. A clearly-defined constriction is shown at the base of the branches. Generally a septum is formed at a short distance from this constriction. In some cases the young branches arise at right angles to the main hyphæ but they later bend toward the direction of the growth of the main filaments.

The young fungous threads are colorless and often very vacuolate (fig. 1 and 2b). With age they become uniformly granular (fig. 2a). The color becomes light or dark brown. The angle widens as the branch lies more nearly perpendicular to the main hypha. The cells of aërial hyphæ are often vacuolate and some seem to be empty (fig. 2 b). Measurements of the

³ All drawings were made by the writer with the aid of a camera lucida using a Bausch and Lomb microscope, eyepiece 10 $\times$ and objective 4 mm.

mycelial cells from a 15-day-old culture on different agars vary in the same medium and show dissimilar ranges in different media as shown in table 1.

TABLE 1

Measurements of the cells of the hyphæ of Rhizoctonia isolated from rice grown on different agar media

MEDIA	LENGTHS IN MICRONS	WIDTHS IN MICRONS	DISTANCE FROM CELL TO SEPTUM OF THE BRANCH IN MICRONS
Corn meal agar.....	36-172	4-12.8	6-32
Patani agar ^a	44-232	4-10	2-28
Potato-dextrose agar.....	20-220	6-12	4-30
Rice agar ^b	36-160	7.2-12	0.8-20
Rice decoction agar ^c	48-176	4.8- 8.8	
Soybean agar ^d	32-240	4-10	4-26
Oatmeal agar.....	24-240	6-11.2	0.8-36
Plain water agar.....	64-248	4- 8.8	4.0-20

^a Patani agar was prepared by boiling 200 grams of ground seeds of patani (*Phaseolus lunatus* L.) in 500 cc. water, mixing the water extract with 20 grams of melted agar, diluting the mixture to 1000 cc. and sterilizing at 15-pounds' pressure for half an hour.

^{b, c, d} Rice agar, rice-decoction agar, and soybean agar were prepared by substituting rice kernels, stems and leaves of rice, and soybean seeds for patani seeds.

The hyphal cells are comparatively long but narrow on water agar and short but wide on rice agar. Those on soybean and patani agars are also long and narrow. Stout hyphal cells are produced on corn meal, oatmeal, potato-dextrose, and rice agars.

Fusion of hyphæ similar to that reported by Ocfemia (1924) for *Helminthosporium oryzae* Breda de Haan was noted on some cultures (fig. 2c, d, and e). It occurs between hyphæ from the same or different parent mycelium. The purpose of this fusion has not been determined. Peltier (1916) states that it occurs either between the hyphæ of the same parent mycelium or between hyphæ from separate colonies.

(b) *Sclerotial bodies*. The denser masses of hyphæ give rise to the formation of sclerotial bodies. These first appear as white soft bodies. Later, they become brown and the outer walls become more rigid. On rice they develop on dead tissues and never on living ones.

The sclerotial bodies are more or less flattened and irregular. However, there are a few which are more or less spherical. Those found in artificial cultures are generally larger than those on rice, due, perhaps, to a more uniform and favorable condition in the culture. The measurements of

sclerotial bodies from old cultures of several agars and substrata (table 2). show that they vary in size not only on different media but also in each medium. Larger sclerotial bodies were produced on corn meal, stems of rice, patani stem, tomato stem, and eggplant stem.

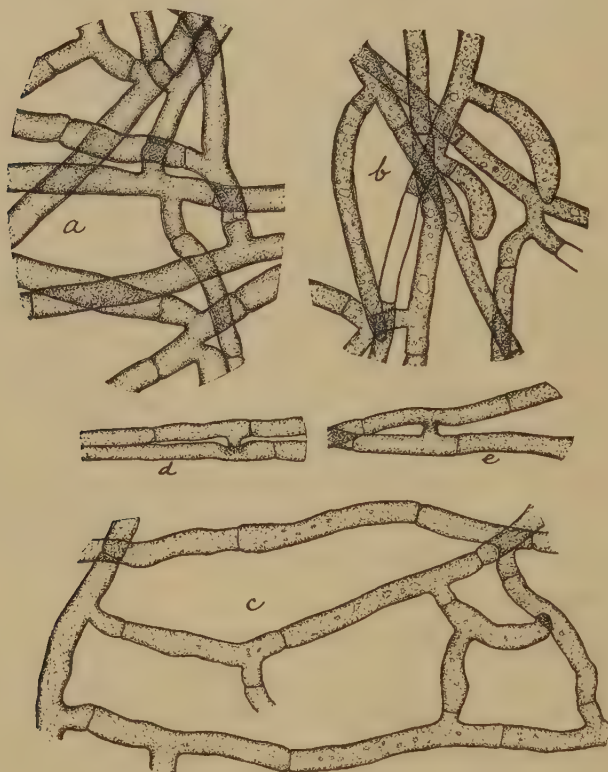


Fig. 2.—(a) A bunch of old hyphae of *Rhizoctonia* showing typical method of branching and the homogeneous character of the cytoplasm in contrast with the cytoplasm of the cells of the hyphae shown in fig. 1. (b) A group of aerial hyphae showing very granular cytoplasm and the presence of empty cells in the middle of the filament. (c, d and e) Fusion of the hyphal cells of the same or different parent filaments found in culture on corn meal agar, patani agar, and sliced corms of yautia.

The sclerotial body consists of dense masses of short irregular, barrel-shaped hyphal cells (fig. 3a, b, and c). The constriction at the septum is

very prominent. Some of the sclerotial cells are empty (fig. 3a). The old sclerotial cells are brown and are more uniform in appearance. If some cells are cut from adjoining cells they may appear and may germinate like true conidia. They germinate within 12 hours at laboratory temperature ranging from 26°C. to 30°C. Germ tubes protrude through the septum of the cells (fig. 3c). Duggar and Stewart (1901) state that when several cells are connected, a germ tube from one cell may pass into and through the neighboring cells. Peltier (1916) observes that the germ tube passes through the adjacent cells which are apparently empty. The writer had occasion to observe the growth of three germ tubes which had just emerged from germinating cells. He found that the growth varied. The first grew 18 microns in one hour; the second, 29.52 microns, and the third, 37.00 microns. After the germ tube had grown out to a certain length, it narrowed near its point of origin and a septum was laid down.

Basidiosporic stage. According to Duggar (1915) there are two main parasitic species of *Rhizoctonia*—*R. crocorum* (Pers.) DC. and *R. solani* Kühn. The same author states that there is not sufficient evidence to show what the perfect stage of *R. crocorum* is. Duggar (1915) further reports that the basidiosporic stage of *R. solani* was first known as *Hypochnus solani* Prill. and Del. Burt found that *Corticium vagum* B. and C. agree closely with *Hypochnus solani* Prill and Del. and might be identified with it. The perfect stage of *R. solani* is known as *C. vagum*. Rolfs germinated the basidiospores of *C. vagum* and produced characteristic *Rhizoctonia* hyphæ and Riehm succeeded in producing both the mycelium and sclerotial bodies (Duggar, 1915). All efforts of the writer to induce the Philippine *Rhizoctonia* on rice to produce the perfect stage were without result.

Cultural studies

When the sclerotial bodies are planted on a medium or substratum they germinate within 12 hours. White fungous threads radiate from them in

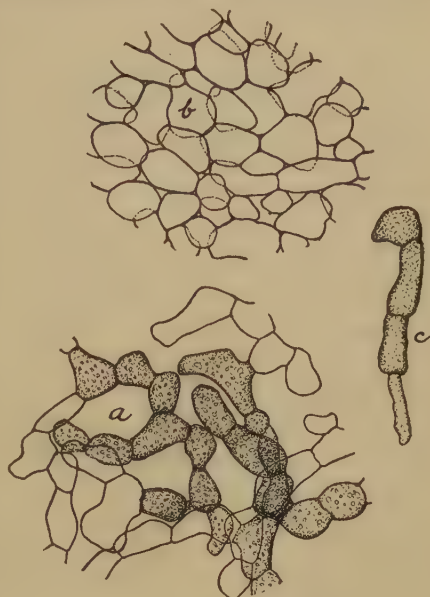


Fig. 3.—(a) Short, plump and barrel-shaped cells of *Rhizoctonia* taken from young sclerotial bodies. Note that the cytoplasm of the cells is very granular. Note also that some of the cells are empty. (b) Portion of the cross section of a sclerotial body of *Rhizoctonia* showing the pseudo-parenchymatous arrangement of the cells. (c) A row of short cells from a sclerotial body of *Rhizoctonia* showing method of germination. Isolated short, barrel-shaped cells of sclerotial bodies of *Rhizoctonia* resemble conidia in shape and in method of germination. $\times$ about 345.

every direction, occupying the entire surface of the medium in a tube or a plate in about two days.

TABLE 2

Sclerotial bodies of the Rhizoctonia of rice from different media and substrata

MEDIA OR SUBSTRATA	NUMBER OF SCLEROTIAL BODIES MEASURED	SIZE IN MILLIMETERS	RELATIVE ABUNDANCE
Potato dextrose-agar.....	20	1.04-3.50×0.84-20.8	Fairly abundant
Corn meal agar.....	20	2.12-3.90×1.00- 1.25	Few
Oatmeal agar.....	20	1.76-2.69×0.95- 1.32	Fairly abundant
Soybean agar.....	20	2.00-3.37×0.50- 0.80	Fairly abundant
Patani agar.....	20	2.00-3.62×1.02- 1.48	Fairly abundant
Rice agar.....	20	1.55-2.63×0.45- 0.73	Fairly abundant
Rice decoction agar.....	20	2.52-3.23×0.70- 1.07	Few
Water agar.....	4	1.47-2.15×0.84- 0.95	Very few
Corn meal.....	20	3.15-5.80×1.30- 1.35	Abundant
Young leaves of rice.....	20	1.72-2.03×0.60- 1.10	Fairly abundant
Stems of rice.....	20	2.80-5.68×0.65- 0.87	Fairly abundant
Patani stem.....	20	3.82-5.04×0.50- 1.08	Fairly abundant
Tomato stem.....	20	2.07-4.80×0.64- 1.03	Fairly abundant
Eggplant stem.....	20	3.87-4.75×0.68- 0.73	Fairly abundant
Rice panicles.....	20	2.75-4.25×0.62- 0.65	Abundant
Young pods of soybean.....	20	1.70-4.50×1.22- 1.32	Abundant
Soybean stem.....	20	2.31-4.18×0.94- 1.20	Fairly abundant
Young pods of patani.....	20	2.40-4.15×0.50- 0.60	Abundant
Potato cylinders.....	20	3.05-4.70×0.85- 0.95	Abundant
Sliced camotes.....	20	3.40-5.25×0.82- 1.30	Fairly abundant
Sliced squash.....	20	4.37-5.45×1.05- 1.37	Abundant
Sliced banana corn.....	30	2.40-3.70×0.57- 1.05	Few
Sliced radish.....	20	4.65-5.65×1.22- 1.63	Fairly abundant
Sliced yautia.....	20	3.80-4.85×0.78- 1.27	Abundant
Sliced sugar cane.....	5	3.80-5.75×1.73- 2.40	Very few
Sliced papaya stem.....	10	3.07-4.58×1.08- 1.27	Few
Sliced patola.....	20	3.75-5.39×1.02- 5.39	Fairly abundant
Sliced corn stem.....	10	2.70-3.70×0.78- 1.73	Few

The growth of *Rhizoctonia* on different media and substrata varies. The differentiation of the cultural behavior was based upon the abundance of hyphæ and sclerotial bodies (table 2). It was found that the growth of this fungus is good on potato-dextrose agar, soybean (*Glycine max* Merr.) agar, patani agar, corn meal, rice panicles (with grains in milk stage), young pods of patani, potato cylinders, sliced yautia tubers (*Xanthosoma sagittifolium* Schott), sliced radish (*Raphanus sativus* L.), sliced squash (*Cucurbita maxima* Duch.) and sliced Spanish patola (*Luffa cylindrica* (L.) Roem.); fair on corn meal agar, oatmeal agar, rice agar, rice decoction agar, leaves and stems of rice, stems of eggplant (*Solanum melongena* L.), tomato (*Lycopersicum esculentum* Mill.), peanut (*Arachis hypogæa* L.), and soybean; and poor on water agar, sliced banana (*Musa sapientum* L.), corn, sliced sugar

cane stems (*Saccharum officinarum* L.), sliced papaya (*Carica papaya* L.) stems, and sliced corn stems. The sclerotial bodies began to develop in three to four days on all media except on water agar and sliced sugar cane stems. On water agar and sliced sugar cane the sclerotial bodies developed in seven days. Except where the growth of the mycelium was rather scanty, the sclerotial bodies produced were either fairly abundant or abundant (table 2). The colonies of nearly all plate agar cultures were not zoned. Zonation occurred on soybean agar, but it was indistinct and not well-defined.

No study was made on the relation of light and temperature to the growth of *Rhizoctonia* in pure culture. With regard to the effect of temperature upon the pathogenicity of this fungus, different authors present different results of their observations. Richards (1921) states that various strains of the *Rhizoctonia* stage of *Corticium vagum*, produce lesions on stems throughout the same range of temperature of from 9° to 27°C. Much damage is produced between 15° and 21°C., while 18°C. is most favorable for tissue destruction and growing-point injury. Serious destruction of tissue takes place at 9°C., and at 24°C. it is of minor parasitic importance. Richards further found that the optimum soil temperature for the development of the potato approximates closely the most favorable temperature for the pathogenic action of *Corticium vagum*. Peltier (1916) found a relatively higher virulence of *Rhizoctonia* during the summer months than during the cooler months of spring and winter. According to Richards (1921) Balls found that a cool temperature favors the pathogenic action of *Rhizoctonia solani* on cotton because at this temperature the growth of cotton is retarded, and Rolfs concluded that a high temperature and abundance of moisture are necessary for the rapid development of this fungus. Rolf's conclusion holds true with the Philippine *Rhizoctonia* of rice. The writer found that high temperature and an abundance of moisture favor the growth and pathogenicity of this fungus under field conditions.

Pathogenicity

In order to prove the pathogenicity of the rice *Rhizoctonia* in the Philippines, three methods of inoculation of rice were followed: (1) by placing the sclerotial bodies on the plants, (2) by inserting the sclerotial bodies under the sheaths, and (3) by placing the sclerotial bodies on the soil near the plants. Young sclerotial bodies with bits of hyphae and the medium adhering to them were used as inoculum. Three potted rice seedlings were used in each inoculation. Two were inoculated and one was used as control. All of them were placed in the damp chamber. With all three methods of inoculation the plants were equally severely attacked by the fungus in damp conditions. Symptoms of blighting appeared within two days as shown by the presence of water-soaked appearance (plates III and IV) and the extrusion of watery exudate (plate IV). The fungus grew rapidly after it

penetrated the plants. Within four days the plants were severely attacked and a heavy growth of long aërial hyphæ was produced (plates III and IV). Often, the hyphæ were a few centimeters long. The rice subsequently fell over, died and decayed rapidly on account of the growth of saprophytic fungi and bacteria. Sclerotial bodies formed on the decaying parts. The results in rice inoculation experiments corroborate those obtained by Mr. Ocfemia in 1917 to 1920.

Further inoculation experiments were made on some vegetables and field crops and it was found that the *Rhizoctonia* on the rice is able to cause damping-off of cotton (*Gossypium hirsutum* L.), culantro (*Coriandrum sativum* L.), pepper (*Capsicum annuum* L.), cucumber (*Cucumis sativus* L.), patola (*Luffa acutangula* (L.) Roxb.), casubhá (*Carthamus tinctorius* L.), peanut (*Arachis hypogæa* L.), onion (*Allium cepa* L.), and squash (*Cucurbita maxima* Duch.); stem rot of sorghum (*Andropogon sorghum* L.) Brot.), adlay (*Coix lachryma-jobi* L.), sugar cane (*Saccharum officinarum* L.), and cassava (*Manihot utilissima* Pohl.); and blight of avocado (*Persea americana* Mill.). The limited inoculation and cross inoculations obtained by the writer are in accord with those previously obtained with this fungus. The results show that under favorable conditions the *Rhizoctonia* occurring in soils in Los Baños attacks rice and many other plants.

Taxonomy

The writer found no criteria on which the specific segregation of the members of the genus *Rhizoctonia* of the Mycelia Sterilia group of the Fungi Imperfecti are based. A culture of *Rhizoctonia* may exhibit often some striking dissimilarity in character and growth of mycelium on one medium in different culture tubes. The cells of the mycelium of a strain vary in size and sometimes in color at different ages and on different media and substrata. Peltier (1916) states that the mycelial cells of the different strains of *Rhizoctonia solani* Kühn. are $65.24-180 \times 5.01-6.57\mu$. The same author found that the length of the mycelial cells of the strains of *R. solani* from *Dianthus* are $50-215\mu$. Duggar (1915) found that the mycelial cells of *Rhizoctonia solani* Kühn are $100-200 \times 8-12\mu$. According to Nacion (1924) the hyphal cells of *Rhizoctonia solani* Kühn causing blight of beans in the Philippines are $102-200.6 \times 7.8-9.2\mu$. The writer's measurements of mycelial cells given in table 1 are not very close to those given by Peltier, Duggar, or Nacion. The writer found that more than 60 per cent of the cells were more than $100 \times 8\mu$. Other morphologic and cultural characters resemble those given by Duggar and Peltier for *R. solani*. *Rhizoctonia solani* Kühn. was reported by Nacion (1924) on beans in the Philippines and it is very widespread and pernicious in the region about Los Baños. *Rhizoctonia* on the bean is easily transferred to other plants, including rice, sugar cane, and other monocots and weeds. The writer considers the *Rhizoctonia* on rice as belonging to the *R. solani* Kühn. group.

LIFE HISTORY OF RHIZOCTONIA SOLANI IN RELATION TO PATHOGENESIS

Method of living over from one season to another and source of infection in the field

The mycelium of the *Rhizoctonia* on rice can live for some time in infected plant tissues, in debris, and in soil where there is enough supply of organic matter and moisture. The fungus, however, lives over from one season to another by means of its sclerotial bodies. It remains in the sclerotial stage during seasons unfavorable to growth. When it is warm and the atmosphere is saturated with moisture, the sclerotial bodies grow, provided that the soil is sufficiently moist. The mycelium radiates from the sclerotial bodies and creeps on the soil until it comes in contact with its hosts, whether grasses, weeds, economic plants, or rotting plant materials. Under field conditions the sclerotial bodies are the chief source of infection. Very little infection, if any, comes from the mycelium which is in the tissues of the host.

Method of dissemination in the field

Rhizoctonia is abundant in most cultivated fields about Los Baños. It may be carried with old grass, straw, hay, or other plant materials from the fields where it exists, to other fields. In plowing, the soil that adheres to the implements may often carry the sclerotial bodies of this fungus. The sclerotial bodies are sufficiently light to be carried from one place to another by the irrigation water and small floods in the fields. In the field during moist weather, as in the moist chamber, the mycelium of *Rhizoctonia* may be seen extending from one part of an infected plant to another to a distance of three to five centimeters (plates III and IV). In this way the fungus spreads, also, from one plant to another with great rapidity. This method of spread is very effective if the plants are set close together so that the leaves and stems interlace. A total destruction of small plots of beans often occurs on account of the mat of stems and leaves over the soil.

Method of infection and effects upon the host tissues

Potted rice plants were inoculated with the mycelium of a young culture of *Rhizoctonia* and then placed in the damp chamber. Within a few hours the hyphae began to creep from the parts of the host inoculated with the fungus. Incipient infections were noted on the foliage reached by the aerial mycelium after 24 hours. The incipient lesions were cut out and decolorized in a solution containing equal volumes of acetic acid and 95 per cent ethyl alcohol. Then they were stained with Planeze's IIb following the method described by Vaughan (1917). Microscopic examinations showed that the hyphae enter the host tissues either directly or through the stomatal openings. The cells of the invaded host became flabby and lost their turgidity. The leaves and sheaths dried out rapidly owing to the loss of much water. The plants finally fell over.

Viability of the sclerotial bodies in water and in different depths of the soil

Eight mason jars, each 25 centimeters high, were used in experiments to test the viability of the sclerotial bodies of the *Rhizoctonia* on rice in water and at different depths of soil with varying amounts of moisture. Four of the jars were filled with moist soil and the other four with dry soil. The moisture content of the moist soil based on dry weight was 23.95 per cent and that of the dry soil, 7.70 per cent. The water-holding capacity of the moist and dry soils was 29 per cent. The air-dry soil was used in the experiment without the addition of moisture. The moisture content of the moist soil was 38 per cent based on its water-holding capacity. The sclerotial bodies from two-weeks old corn meal cultures were buried in the dry soil at a depth of 5 centimeters in the first mason jar, 10 centimeters in the second, and 20 centimeters in the third. In the fourth jar the sclerotial bodies were placed on the surface of the soil. The same procedure followed in moist soil. The sclerotial bodies were plated out on sterilized corn meal or potato-dextrose agar at intervals of a month to determine whether or not they were still viable.

It was found that the sclerotial bodies buried at the depths of 5, 10, and 20 centimeters in moist soil became sponge-like in texture and lost their vitality after four to five months. Some of the sclerotial bodies which were placed on the surface of moist soil grew and produced new or secondary sclerotial bodies. The mother sclerotial bodies were found to live for five months on the surface of moist soil. The sclerotial bodies buried at different depths in dry soil lost their vitality in six to seven months. On the surface of dry soil the sclerotial bodies were viable for seven months. The sclerotial bodies which were submerged in water lost their viability in two to three months.

The viability of sclerotial bodies in water and in soils with different moisture contents varies. The variation seems to depend upon the moisture contents of the soil and not upon the depths at which the sclerotial bodies were buried in the soil, as shown in the following summary:

Viability of sclerotical bodies

Under water..... 2 to 3 months

In the soil

Moist with 38 per cent of moisture based on water-holding capacity.

On surface—indeinitely. The sclerotial bodies on the surface of moist soils germinated and produced an abundance of secondary sclerotial bodies. A viability of five months was found in the original, or mother sclerotia.

5 cm. below the surface..... 4 to 5 months

10 cm. below the surface..... 4 to 5 months

20 cm. below the surface..... 4 to 5 months

Dry soil

On surface..... 7 months

5 cm. below the surface..... 6 to 7 months

10 cm. below the surface..... 6 to 7 months

20 cm. below the surface..... 6 to 7 months

CONTROL MEASURES

Burning over infected soils. To prevent the effects of *Rhizoctonia* it would be necessary to treat the soil in order to destroy this fungus. The treatment should be such as not to affect the productivity of the soil. The best method but practicable only in plantings on a small scale, as in seed beds and seed flats, is the sterilization of soil by heat. In badly infected fields the dried plant materials should be burned in order to destroy the sclerotial bodies. In a place where there is plenty of combustible materials "surface firing" may be resorted to. This process will destroy the mycelium and sclerotial bodies of *Rhizoctonia* in plant stubbles and on the soil. Burning should be done during the dry season. After a heavy rain the soil should be plowed under so as to bury the sclerotial bodies which may be left uninjured by the burning over of the land. Then the ground should be harrowed and pressed with a roller. Buried sclerotial bodies will be killed within five or six months.

Avoid close planting. Close planting favors the growth of *Rhizoctonia* because it keeps the soil and air between the plants moist, and the spread of the fungus from one plant to another is comparatively easy. Rice should not be broadcasted in an infected field but should be planted or drilled in rows at least 50 centimeters apart.

Effect of flooding infected soils. Another method of exterminating the fungus is by flooding an infected field and keeping it under water for three months. This is very easily accomplished in paddies and in seed beds. The sclerotial bodies lose their vitality if kept under water for about three months.

Crop rotation. Crop rotation can not exterminate *Rhizoctonia* because this fungus attacks almost all field crops and weeds. Its growth in soil where there is an appreciable amount of organic matter and moisture is continuous. The growth may be checked by unfavorable conditions, but the sclerotial bodies can live over in an adverse environment until such time when moisture and other factors favor their germination.

Chemical disinfection of soil. Johnson (1914) used 1-50 formalin at the rate of about 7.0 liters for every 0.09 square meter of soil to kill the damping-off fungi as *Rhizoctonia*, *Pythium* and others. Hibbard (1910) states that liming the soil would be exceedingly beneficial because *Rhizoctonia* grows well in soil of acid reaction. In connection with acidity requirement of *Rhizoctonia*, Matsumoto (1921) states that in general all the strains he tried grew well on media with an exponent somewhat larger than pH 3.8.

Resistant varieties. Further work is in progress to determine the relation of different varieties of rice to *Rhizoctonia* infection.

SUMMARY

1. The common and widely distributed cosmopolitan soil fungus *Rhizoctonia* attacks both the seedling and maturing rice. The disease often causes serious reduction of stand of rice planted under upland conditions.

2. Warm temperature and abundance of moisture are favorable for its ravage and spread. Under these conditions *Rhizoctonia* is an aggressive parasite.

3. *Rhizoctonia* attacks rice and causes two types of diseases, the stem rot and the blight.

4. Artificial inoculation shows that it is capable of infecting rice when its sclerotial bodies are placed on the plant, under the sheaths, and on the ground close to the plants. *Rhizoctonia* attacks most Philippine garden and field crops and with marked virulence during their seedling stages.

5. The *Rhizoctonia* attacking rice and other plants in the Philippines is very similar to *Rhizoctonia solani* Kühn and is considered in this work as belonging to the *R. solani* group.

6. The fungus gains entrance into the living tissues of rice through the stomata and uninjured parts.

7. This fungus passes over adverse conditions in the Philippines by means of its sclerotial bodies.

8. Thick plantings make good habitats for the fungus.

9. In seed beds the disease may be controlled by sterilizing the soil with heat, treating the soil with 1-50 formalin, and by planting the seeds farther apart.

10. Flooding of infected soils will destroy the sclerotial bodies of the fungus. Plowing the fields at the end of the rainy season will bury and kill many of the sclerotial bodies and reduce sources of infection for the following season.

11. Further work is in progress testing the resistance of different varieties of rice in the Philippines to the *Rhizoctonia* disease.

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ILLUSTRATIONS

PLATE I

Specimens of rice showing dwarfing of the youngest leaf in the stalk at the extreme right and the characteristic gray to greenish or bluish gray spots on the leaves (*l*) and sheaths (*sh*) due to *Rhizoctonia*. The dark brown borders of the spots, even after several patches have coalesced, are still distinct. The specimens were collected from the College Farm by G. O. Ocfemia in 1918 from a paddy broadcasted to rice and drained. Slightly reduced.

PLATE II

Compact, short, and aborted panicles of rice, tightly held in boots, resulting from serious infection by *Rhizoctonia*. Note the *Rhizoctonia* lesions which have coalesced (*sp*) on the leaf sheath in the specimen to the left. The specimen was collected by G. O. Ocfemia from the College Farm in 1919 from rice drilled in rows 50 centimeters apart. $\times \frac{2}{3}$.

PLATES III AND IV

Nineteen-day-old rice seedlings grown in pots of sterile soil inoculated on October, 1918, with sclerotial bodies of cultures 027 and 029, respectively. Isolated by G. O. Ocfemia, from the *Rhizoctonia* lesions on the sheaths of rice. The inoculated plants were placed in moist chambers for one week and the seedlings turned yellow and died and were covered with long strands of mycelium. The same condition occurs in very crowded planting in the field during moist days. Note the dark spherical bodies of the yellowish exudate on the leaves of the seedlings on plate IV and the mycelium on the pot in plate III. $\times \frac{1}{2}$. (All photographs used in this paper were taken by the Bureau of Science, Manila, P. I.).



PLATE I



PLATE II



PLATE III



PLATE IV

A STUDY OF THE RATE OF GROWTH OF BERKSHIRE-NATIVE PIGS UNDER ORDINARY CONDITIONS¹

POLICARPO C. CALMA

WITH ONE CHART

INTRODUCTION

In the Philippines, hogs are raised by nearly every family outside of the cities. Many more families are interested in the raising of swine than in the production of any other class of meat making animals. In many instances, pigs are kept to utilize the kitchen waste and the table refuse as well as grain that cannot be disposed of profitably. The families use the pigs in a number of ways. Some are sold for *lechon*², some for breeding pigs, and some for meat. Most of the people of the Islands depend upon swine for the greater part of their meat supply. Owing to the importance of hogs in this country investigations on their rate of growth would seem to be of economic advantage.

Review of literature

Peña (1924) found that the pigs having the largest proportion of Berkshire blood gained the fastest, and the pigs having smallest proportion of Berkshire blood gained the slowest.

Henry (1897) of the Wisconsin Agricultural Experiment Station found that the average birth weight of pigs is 2.2 pounds, or 1 kilogram.

Carmichael and Rice (1920) working on the variations in farrow with special reference to birth weight of pigs, found the average weight to be 2.55 pounds, or 1.15 kilograms. They also reported that the average weight of the pigs in small litters is greater than the average weight of pigs in large litters.

Object of the experiment

The object of the present work was to study the rate of growth of Berkshire-Native grade pigs.

The experiment was conducted in the Department of Animal Husbandry, College of Agriculture, Los Baños. The study was begun April 15, 1923, and was closed January 26, 1924.

¹ Thesis presented for graduation, 1924, with the degree of Bachelor of Agriculture, No. 234. Experiment Station contribution, No. 397. Prepared in the Department of Animal Husbandry under the direction of Mr. Mariano Mondoñedo.

² *Lechon*—roast suckling pig.

MATERIALS AND METHODS

Materials

The materials used in these experiments belonged to the Animal Husbandry Department, College of Agriculture. The study was made on ten litters of Berkshire-Native grade pigs.

The feed for each lot was composed of rice bran, ground corn, and copra meal. In addition to these feeds, charcoal mixture (1 part sodium chloride and 1 part charcoal) was kept in a small wooden box accessible to the pigs. Camote pasture was used along with the ration. From time to time, the pigs were transferred from one pasture to another. Besides the camote pasture, in many instances the pigs were allowed to graze in a grassy yard.

Plan of the experiment

From April 15 to August 31, 1923, pregnant sows, both Native and Berkshire-Native grades, were observed. Symptoms of parturition were carefully noted. A few days before farrowing, each sow was separated from the other hogs and placed in a farrowing pen.

To determine the rate of growth of the different grades of Berkshire-Native pigs, the litters were divided into lots according to the amount of their Berkshire blood.

Lot I was composed of pigs $\frac{7}{8}$ Berkshire-Native.

Lot II was composed of pigs $\frac{1}{2}$ Berkshire-Native.

Lot III was composed of pigs $\frac{7}{16}$ Berkshire-Native.

At the beginning of the experiment there were seventeen, thirteen, and forty-eight pigs in lots I, II, and III, respectively.

So far as possible the sows and their litters were given the same care and attention. The sows were given light feed in the form of slop for four to five days after farrowing. The time consumed in getting the sows to full feed was from a week to ten days, depending on the size and thrift of the litters. During the first week after parturition, the litters were confined in the hog house, the sows being allowed to exercise in the yards adjoining the farrowing pens. The pigs were not allowed to go out with the sows until they were strong enough to roam around. The length of time they were confined varied from three to four weeks depending upon their growth and development. On rainy days the sows and their young were kept in the hog house.

Weighing. The pigs were weighed once a week to determine the rate of growth. The initial weight was taken within forty-eight hours after farrowing.

System of feeding. Great care was exercised in feeding the pigs so that each one could get its own ration.

They were given a ration by weight of two parts copra meal, three parts rice bran, and one part corn. The pigs were fed twice a day, morning

and afternoon. The ration was given in the form of a thin slop. An effort was made to give the animals only as much feed as they could consume within ten to twenty minutes. The general rule followed was to give less feed in the morning to induce the pigs to eat more of the camote vines in the pasture and to exercise. When the mother was fed, the suckling pigs were carefully observed, to note at what age they began to eat from their mother's ration. When this commenced, which was usually at the age of three weeks, a creep was made so that they could eat from the trough without being disturbed by the mother.

Weaning. The pigs were weaned gradually. The time for weaning the pigs depended upon their growth and development. Some, as in the case of the thrifty litter of sow No. 169, were weaned gradually as early as the seventh week, while other litters that did not grow well were weaned as late as the fourteenth week.

Castration. All male pigs, except those that were desirable for breeding, were castrated when from seven to ten weeks of age, depending upon their development. They were turned out to pasture or kept in the pen for a time after the operation.

Sanitation. The quarters occupied by the pigs in the hog house were cleaned daily, morning and afternoon. All the pigs that did not grow normally were carefully observed, and fecal examinations made. On every weighing day the pigs in all the lots were examined for the presence of external parasites. The examination was made particularly around the ears, flanks, and inside the legs. When pests were discovered, the pigs were either washed twice a week with 3 per cent creoline solution, or a mixture of two parts kerosene and one part coconut oil was used.

RESULTS

Table 1 gives the weight of each lot of pigs. By referring to this table it may be seen that the average initial weight of the pigs was 0.96 kilogram in lot I, 0.99 kilogram in lot II, and 0.94 kilogram in lot III. This shows no appreciable difference between the initial weight of the pigs in the three lots. Again, it may be seen from the same table that the average weekly gain in weight was more pronounced in lot I (7/8 Berkshire) except in the first five weeks. Lot II (1/2 Berkshire) was next best, while lot III (7/16 Berkshire) showed the poorest growth. It may also be noted that the pigs in all the lots doubled their birth weight by the second week and trebled it by the fourth week. At the eighth week the average weight was 5.90 kilograms in lot I, 5.39 kilograms in lot II, and 4.22 kilograms in lot III. At this age the pigs in lot III, in which the proportion of Berkshire blood was lower than in the pigs in either of the other two lots, showed the slowest growth. In the twenty-fifth week, the pigs weighed 15.65 kilograms in lot I, 13.61 kilograms in lot II, and 11.1 kilograms in lot III. In other words, the pigs in lot I were 15 per cent heavier than those in lot II, and 41

cent heavier than those in lot III; and the pigs in lot II were 22.6 per cent heavier than those of lot III. Lot I (7/8 Berkshire) also showed a distinct superiority over the other lots in the quality of the animals. This corroborates the findings of Peña (1924) who observed that his lot of 7/8 Berkshire surpassed in quality his other lots of a lesser proportion of Berkshire blood.

TABLE 1

Showing average weekly gain or loss of the pigs in the three lots

Week- ly age	LOT I			LOT II			LOT III		
	No. of animals	Average weekly weight	Average weekly gain	No. of animals	Average weekly weight	Average weekly gain	No. of animals	Average weekly weight	Average weekly gain
<i>Initial wt.</i>		<i>kgm.</i>	<i>kgm.</i>		<i>kgm.</i>	<i>kgm.</i>		<i>kgm.</i>	<i>kgm.</i>
	17	0.96		13	0.99		48	0.94	
1	16 ^a	1.32	0.36	12	1.31	0.32	46	1.22	0.28
2	15	1.91	0.59	12	1.96	0.65	45	1.37	0.51
3	15	2.58	0.67	12	2.78	0.82	45	2.35	0.62
4	15	3.06	0.48	12	3.40	0.62	45	2.94	0.59
5	13	3.84	0.78	12	3.93	0.53	45	3.34	0.40
6	13	4.58	0.74	12	4.36	0.43	45	3.65	0.31
7	13	5.14	0.56	12	4.70	0.34	45	3.73	0.08
8	13	5.90	0.76	12	5.39	0.69	45	4.22	0.49
9	13	6.80	0.90	12	5.93	0.54	45	4.75	0.53
10	13	7.66	0.86	12	6.47	0.54	45	5.04	0.29
11	12	8.45	0.79	12	7.14	0.67	45	5.41	0.37
12	12	9.12	0.67	12	7.52	0.38	44	5.75	0.34
13	12	9.52	0.40	12	8.01	0.49	44	5.93	0.18
14	12	9.88	0.36	12	8.45	0.44	44	6.04	0.11
15	12	10.23	0.35	12	8.99	0.54	43	6.49	0.45
16	12	10.75	0.52	12	9.58	0.59	41	6.71	0.32
17	12	11.23	0.48	12	10.25	0.67	40	7.54	0.83
18	11	12.19	0.96	12	10.91	0.66	40	7.45	-0.09
19	10	12.07	-0.12	12	11.67	0.76	39	8.01	0.56
20	10	12.66	0.59	12	12.49	0.82	39	8.40	0.39
21	10	13.03	0.37	12	12.95	0.46	39	8.75	0.35
22	10	13.71	0.68	12	13.40	0.45	39	9.19	0.44
23	10	14.45	0.74	12	12.97	-0.43	18 ^b	9.99	0.80
24	10	15.10	0.65	12	13.47	0.50	17	10.87	0.88
25	10	15.65	0.55	12	13.61	0.14	17	11.10	0.23

^a 1 pig died. The decrease in number in each case is result of death of animals.

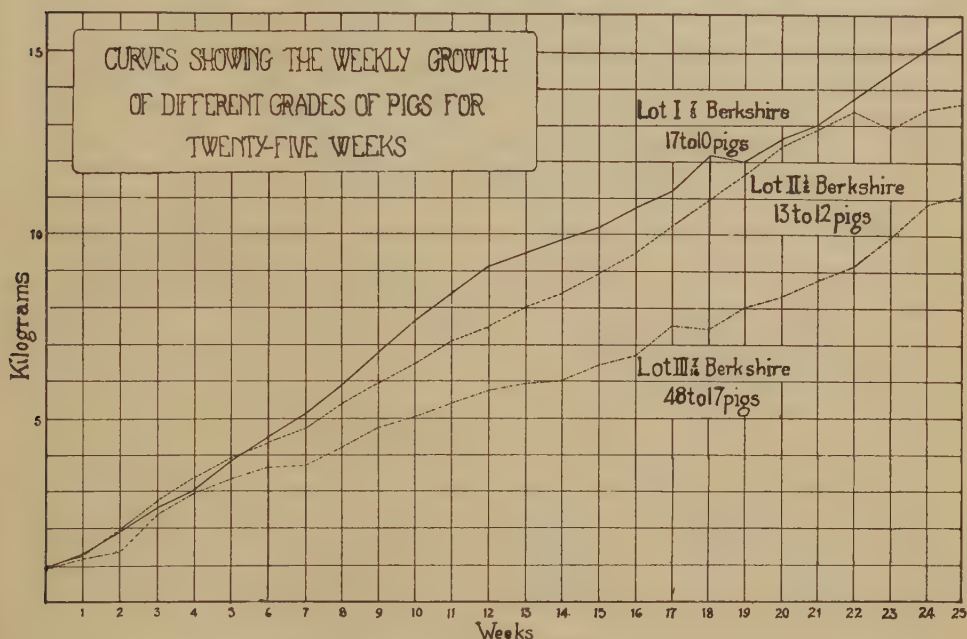
^b 21 pigs did not reach the age of 23 weeks.

The results are shown in the chart. Lot I shows a rather regular curve of growth from the beginning up to the end of the experiment, except in the nineteenth week. Lot II ranks second, while lot III shows a rather irregular curve of growth.

Observations

In every litter of pigs studied there was one or more members much weaker (runts) than the others. In general, the individual pigs in large litters were smaller at birth than those of the small litters.

The pigs in all the lots began to eat at about the third week. When the pigs were eating well, they were gradually weaned, and this did not affect their growth. Castration, between the seventh and the tenth weeks, did not materially disturb growth, probably because the operations were almost bloodless.



The pigs in lot III were observed at the seventeenth week to be heavily infested with lice (*Hæmatopinus suis*). The pigs were restless, and rubbed themselves on posts, wires, and other convenient objects. Their coats appeared dry and hard. Treating the animals with 3 per cent creoline solution or with a mixture of equal parts coconut oil and kerosene twice a week got rid of the parasite.

Some of the pigs did not grow normally. Samples of their feces were examined and showed infestation with *Ascaris*, *Trichiuris*, and *Oesophagostoma*. These pigs developed into pot-bellied profitless runts.

Mortality

When the pigs were strong, they were allowed to run with their dams in the grassy yards. Although carefully cared for, still some of them died.

The percentage of death was highest in lot I (7/8 Berkshire), second in lot III; and lowest in lot II. These figures indicate that in this experiment, pigs with a high proportion of Berkshire blood were more likely to succumb to adverse conditions than those with a low proportion of Berkshire blood. It is interesting to note that it was lot II (1/2 Berkshire) which was most likely to survive the first five weeks. Post-mortem examinations of all dead pigs were made, except those that died from an accident. The examination invariably pointed to kidney worms (*Stephanurus dentatus*) as the primary cause of death. This observation confirms the findings of Gonzalez and Lago (1923) who reported that kidney worms were the most active agents in causing the mortality of Duroc-Jersey, Berkshire, and the grades of these breeds at the College of Agriculture. They also state that in the improved breeds the percentage of mortality from kidney worms was noticeably high, especially when it is considered that most of the animals died young. The total percentage of mortality of the pigs in this experiment was 41.2 in lot I, 7.7 in lot II, and 18.7 in lot III, as may be seen in the following tabulation.

	<i>Initial number of pigs</i>	<i>Number alive after 25 weeks</i>	<i>Percentage of mortality</i>
Lot I 7/8 Berkshire-Native.....	17	10	41.2
Lot II 1/2 Berkshire-Native.....	13	12	7.7
Lot III 7/16 Berkshire-Native.....	48	39	18.7

DISCUSSION OF RESULTS

Table 1 shows that in all the lots there was no significant difference between the average initial weights of the pigs. The average initial weight in lot I was 0.96 kilogram, in lot II 0.99 kilogram, and in lot III 0.94 kilogram, giving an average of 0.96 kilogram. This result is within the range of the average initial weight of the pigs studied by Peña (1924). It also follows closely the results obtained by Henry (1897). In table 1 and in the chart it may be seen that there is a marked difference in the rate of growth of the pigs in the three lots. Lot I (7/8 Berkshire) gave the best weekly growth, except in the first five weeks when this lot was slightly below lot II. Lot II showed a smaller weekly gain and lot III the smallest gain.

SUMMARY AND CONCLUSIONS

1. The average initial weights of the pigs with different amounts of Berkshire blood was not materially different.
2. In general the individual pigs in large litters were smaller than those of the smaller litters. Frequently, in a litter one or more members were much weaker than the others.
3. The grade pigs with a greater proportion of Berkshire blood grew faster than those pigs with a lesser proportion of Berkshire blood.

4. Pigs in lot I (7/8 Berkshire) showed a distinct superiority in quality over the pigs in the other lots. The type, conformation, and appearance of the pigs in lot I were more Berkshire than Native.

5. Castration between the seventh and the tenth weeks did not impair the normal growth of the pigs.

6. Intestinal worms were common among the hogs and were injurious to their health, hindering their development. Hogs infested with these parasites developed pot-bellied bodies.

7. The highest percentage of mortality of the pigs in all the lots occurred during the first five weeks of their lives.

8. The highest mortality of pigs was registered by lot I, composed of 7/8 Berkshires, and the lowest by lot II, composed of 1/2 Berkshire-Native pigs.

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A REVIEW: "CITRUS DISEASES AND THEIR CONTROL"^{1,2}

The book is the most complete and authoritative treatment attempted thus far on all known diseases of citrus. Some idea of the scope of the work may be gathered from the general topics covered. The authors discuss the occurrence and the differences in the severity of the citrus diseases in different localities; their effect upon the citrus industry; and the grouping of diseases as to the parts of the plant affected. Also a complete history of the citrus-disease investigations, the origin and spread of important species, varieties, relatives, and hybrids of citrus are presented and the important diseases of each pointed out. And the classes and types of citrus diseases, and the latinized descriptive common names of the diseases are given.

Enumeration is made of the countries which grow citrus giving the diseases present in each country. The conditions which affect the occurrence and severity of citrus diseases and control measures in general are discussed.

The diseases of citrus are grouped into those that affect the roots and trunk, diseases of the branches, twigs, and leaves, and maladies attacking the fruits. The authors devote 121 pages to the discussion of the root and trunk diseases, 136 pages to diseases of branches, twigs and leaves, and 195 pages to the diseases of fruits. Keys for the identification of each of the diseases in each group are given. The individual diseases of each group are discussed according to symptoms, causes, contributing factors, and control measures.

All in all the book is a comprehensive and complete discussion of all known citrus diseases, with special attention to those occurring in the United States. The book is profusely illustrated and is written in an interesting manner. The authors are to be commended for their splendid work in putting together this vast amount of literature in such an interesting, clear, and complete account.

G. O. OCFEMIA

Of the Department of Plant Pathology

¹Fawcett, Howard S., and H. Atherton Lee. 1926. Citrus diseases and their control. xii+582 p., 205 fig. New York: McGraw-Hill Book Company, Inc.

²General contribution from the College of Agriculture, No. 176.

The task of an investigator requires for its success the toughness of a soldier, the temper of a saint, and the training of a scholar.

—HUMPHRY DAVY.

ABSTRACT¹

The effect of certain chemical solutions on haustorium formation of *Loranthus Philippensis*. FRANCISCO T. PALAD. (*Thesis presented for graduation, 1925, from the College of Agriculture No. 235. Experiment Station contribution, No. 398*).—Different *Loranthus* roots were bound by masses of moss, and were kept moist with water. One kind of solution with a fixed concentration was applied to each mass to determine its effect on haustorium formation.

Experiments on *Loranthus* seed germination and attachment, and on the rate of ascent of sap in the parasite and its common hosts were also carried out.

The author gave the following results:

Germination and attachment. None of the *Loranthus* seeds germinated in the dark. Of the seeds tried for germination on trees, 33.3 per cent germinated and were able to attach themselves on rough barks. None germinated on smooth barks.

The rate of ascent of sap. The result is shown in the following tabulation:

<i>Plants</i>	<i>Centimeters per second</i>
Ficus spp.	.1173
Graptophyllum pictum....	.0631
Citrus spp.....	.1061
Persea americana.....	.1323
Hibiscus rosa-sinensis.....	.0868
Cordia myxa.....	.2071
Loranthus philippensis.....	.2205

Hosts that have the rate of ascent of sap nearly equal to that of the parasite are resistant. These plants are able to absorb from the soil the amount of water the parasite withdraws from them.

The effect of chemical solution. The result is shown in the following tabulation:

<i>Chemical solution used</i>	<i>Concentration per cent</i>	<i>Positive effect</i>	<i>Negative effect</i>
Ferric chloride.....	0.25		Negative
Potassium nitrate.....	1.	Positive	
Potassium sulfate.....	1.		Negative
Glucose.....	1.	Positive	
Magnesium chloride.....	1.		Negative
Calcium acid phosphate.....	1.	Positive	
Calcium chloride.....	1.		Negative
Rain water (control).....	0.00		Negative

¹Abstract prepared as part of the required work in English 6, College of Agriculture.

Chemical solutions of less concentration than the cell sap of the roots stimulated haustorium formation, while those of the same concentration as the cell sap produced negative results. The negative result obtained was due to the plasmolysis of the root cells.

—*Abstract by F. M. Sacay.*

There are two colleges—the one on the campus and the one in the field * * *.

The great body of alumni constitutes the faculty of the College in the Field. Its laboratories are the great laboratories of industry, the opportunities afforded by general business and the professions, by the study of the rising generation through a hundred thousand positions in public education, all of which has offered opportunity for ascertaining the needs of the times such as does not come to members of the faculty on the campus, of necessity more removed from the pulsating heart of democracy and still attached to its traditions.

And it is to be remembered that this College in the Field dearly loves the College on the Campus as grown-up sons and daughters love the old home which sent them forth; and that any criticisms or suggestions from the field are made with the kindest of feeling toward the College on the Campus, which it supports morally and financially for the general welfare.—SUPERINTENDENT F. D. BOYNTON, Ithaca, N. Y., in the *Journal of Education*. Reprinted in *What the Colleges are Doing*.

All the men who have made good with me have been men who saved. I could never interest myself in a man who did not.—H. K. CURTIS, *President, Curtis Publishing Company*.

“WE WANT HOMESTEADS”

The subject of obtaining and developing land has always been a live one among students of the College of Agriculture. It represents one of the foremost ambitions of all the students. Public accusations that they did not possess such an ambition was always taken by them as a joke for while they could not often realize their ambitions at once, still they all knew that plans for ultimately accomplishing this end lay uppermost in their minds. Under former conditions the way to realization was one of patient waiting for those without resources, since such had to work for wages for a time to secure a small initial capital.

These ambitions and desires on the part of College of Agriculture students became articulate on the occasion of the Occupation Day celebration of August 13, when they adopted and issued the following “Manifesto” setting forth clearly their desires, beliefs and intentions—so clearly that there can be no further chance of misunderstanding. This “Manifesto,” as given to the public, has aroused considerable discussion, calling out constructive comment from the daily press, and has enlisted the active attention of legislators to the extent of the introduction of several bills looking toward facilitating the securing and opening up of public land by Filipino young men.

A MANIFESTO FROM THE STUDENTS OF THE COLLEGE OF AGRICULTURE
Occupation Day, August 13, 1926

THE PHILIPPINES FOR FILIPINOS

We want homesteads!

KNOW ALL MEN BY THESE PRESENTS:

1. We believe that the available public agricultural lands of the Philippines should be occupied at once by Filipinos.
2. We believe that this should be for us the real spirit of this Occupation Day, August 13, 1926, and that America is here to aid and abet us in this.
3. We believe that a campaign toward this end should begin today, that will be so active and so effective that August 13, 1927, may see the best of remaining public lands filed on by Filipinos.
4. We herewith deny and denounce all statements and implications that students of the College of Agriculture do not have an active interest in the taking up of public lands, with intention of improving them and making them add to the wealth of this country
5. Six hundred and fifty College of Agriculture students (100 per cent) herewith publicly and emphatically affirm that they are ready to file on six hundred and fifty homesteads *en seguida*, if they can have the proper and effective assistance of the governmental entities concerned, in accomplishing this forthwith.

6. The unavoidable inability of members of this body to travel and to locate homesteads should be offset by the active co-operation of the entire body of forest rangers. We ask that forest rangers be requested to locate and submit tentative location plats of all good unoccupied homestead areas left in the following regions:

Tayabas
Cagayan Valley
Nueva Ecija
Camarines Norte
Camarines Sur
Mindanao (Bukidnon, Cotabato, Davao)

We request that each plat be accompanied by field notes showing:

- a. Height above sea level, drainage, topographical character, etc.
- b. Present vegetation on land; nearness to forest.
- c. Character and quality of soil with depth to subsoil.
- d. Availability of water throughout the year.
- e. Availability of open pasture lands in the vicinity.
- f. Accessibility to transportation routes, roads, railroads or steamer lines.

We do not care to locate in the midst of some vast cogonal. We request that preferably areas of the *most desirable character* be indicated that will be large enough to include groups of from five to twenty or more homesteads since our developmental strength will be greater in groups. We request that all such information be forwarded to this College as rapidly as obtained.

7. We request that special means be adopted by Bureau of Lands to facilitate action on applications by all students and graduates of the College of Agriculture. The *previous* indications by Bureau of Forestry rangers should greatly facilitate action of Bureau of Lands and will certainly very greatly facilitate selection and filing by members of this body.
8. We believe that if there is anything that can possibly be done to simplify the homestead law, the Legislature should take immediate action toward this end. The present procedure is too complicated and dilatory and uncertain for the common man. We believe this whole matter is of such vital importance to the Filipino people that the whole machinery of government throughout should be mobilized and focused on the rapid allotment of Philippine lands to Filipinos.
9. With the effective co-operation in all respects of other arms of the government, there will never be any doubt that students and graduates of this College will take the most energetic and immediate action toward effective "occupation of the Philippines by Filipinos".

(Signed) GAUDENCIO A. VENTURA, *President*

MARCELO B. PEÑA, *Vice-President*

CLEMENTE JULIANO, *Treasurer*

Representing 650 students of the College of Agriculture.

(This document also carried the signatures, as witnesses, of forty-three representative students.)

COMMENTS FROM MANILA PRESS

* * * The resolution drafted by the students of the College of Agriculture is a trumpet-call to all citizens to attend to a matter of great pith and moment. Something must be done to remedy the defects of the present homestead law so as to facilitate the settlement of the vast stretches of Philippine territory. The greater the number of small landowners among the Filipinos, the better for the Filipino nation and the safer for an independent Filipino democracy.

—*The Philippine Collegian* (Official organ U. P.), August 23, 1926.

The students of the College of Agriculture at Los Baños issued what they call a "Manifesto" urging that they be granted homesteads which they can occupy and cultivate upon graduation. . . .

These young men are to be commended for their determination to go straight from college to the farm. Their desire that the agricultural public lands in the islands should be immediately taken up by Filipinos, is shared by our people. Unfortunately, however, there are many factors that stand in the way of this great consummation. One of them, as the students point out, is the long, tedious and complicated procedure for getting title to homesteads. This situation should be relieved.

—Editorial from *Philippines Herald*,
August 18, 1926.

Students of the College of Agriculture at Los Baños are clamoring for legislation to facilitate their entry into the land-owning farmer class promptly upon their graduation. Their purpose is above reproach. They should become landowning farmers as quickly as possible. The country needs the development for which their instruction in college is intended to prepare them. The waste areas of undeveloped lands need trained young men with the spirit of the pioneer to render them productive. Official encouragement should be given them to the greatest degree consistent with public interests.

But there is a limit to what these ambitious young men should expect of their government. They get their education at public expense. Their schooling from primary room to graduation hall means an expense to the taxpayers. In view of this fact they should be willing to dig and dig hard to get themselves established after graduation. To get their first foothold is not easy. * * *

The College of Agriculture and other agricultural schools face a serious problem of placing their graduates advantageously, just as all other schools and colleges do in the Philippines. Lack of development here limits the number of jobs. Large and growing commercial houses would produce an abundance of jobs. Extensive modern plantations would create a heavy demand for the trained youth. If agricultural development were given a chance here the worthy college graduate would have an abundance of places to work, to establish himself in a permanent position or to sell his services on a salary basis until ready in experience and capital to start on his own.

—Editorial from *Daily Bulletin*,
August 19, 1926.

The *Land Courier*, journal of the Bureau of Lands ran a long editorial on this movement of the students.

Those who watch the clock at 20 are watchmen at 60.

—*Efficiency Magazine*.

EXCHANGE NOTES

Fungi, the type of parasitic plant growth that makes little scabs on fruit and leaves of trees, are an important cause of disease in human beings. It has become so usual to think of bacteria as the principal source of infections that it is rather surprising to learn that over 20 per cent of the maladies of the tropics are due to fungous growths, according to a statement by Dr. Aldo Castellani, an international authority on tropical disease, in a recent lecture before the College of Medicine at the University of Illinois.

Ringworm was one of the first afflictions shown to be caused by a fungus and it is now known that similar parasitism may attack any system of the body, the skin being the most frequently invaded and the nerves the least. Many bronchial troubles and diseases of the tonsils, as well, may be traced to such a source.

Dr. Castellani makes a strong appeal for more cooperation between medical science and the botanical specialists who study fungi and the diseases they produce in higher plants. Such cooperative research is one of the objectives of the department of tropical medicine at Tulane University at New Orleans where Dr. Castellani is now stationed as professor of Tropical Hygiene.

—*Science.*

The farmer is a producer. He changes the elements of nature into the raw materials that manufacturers use. Only in certain fruits and vegetables does he produce the finished products used by the ultimate consumers.

* * * His overhead consists of invested capital in land, in material such as seed, fertilizer and implements, and in labor.

* * * Being thus unable to very materially control his overhead expense in its relation to future markets, the only thing he can do is to produce as much out of the overhead involved as he can, and through the various marketing machinery of his own creation do his best to get a fair price for his products. Only a few can successfully play the one-crop game. The rest must depend largely upon diversified production with a fixed plan which they adhere to regardless of changes in market prices. We believe the salvation of agriculture lies in steadying production by sticking to a definite plan.

—*Successful Farming.*

1. Do not kink or bend garden hose sharply. Keep on a hose reel when not in use.
2. Keep in a cool, dark place.
3. Keep free from oil and grease.
4. Do not leave water in hose in cold weather.
5. Small leaks can be repaired with rubber cement and tire tape. In the case of large leaks, cut hose and put in a new coupling.

—*The Prairie Farmer* (Illinois).

Nothing but advantage and inspiration for the physical and spiritual life can come to those who love flowers and devote some of their spare time to cultivate them. Flowers are not to be considered a luxury in the sense of other articles, for the benefit of flowers upon the mood and general health of people is well known. The botanists have made many discoveries but there is still a large field to be explored. For instance, we know very little about the ethereal oil which produces the fragrance. At present we cannot distinguish between the different scents of flowers—we speak of sweet-smelling Roses, sweet-smelling Violets, sweet-smelling Jasmine, sweet-smelling Carnations, and so on in endless monotony. It is generally acknowledged that forest air is beneficial; why not the different scents of flowers? The possibility of realizing aesthetic values from the perfume of the flower has scarcely begun to be investigated. An artist has recently invented a perfume instrument played with keys like a piano. When a key is pressed, some particular odor is wafted to the audience, as are the notes of an orchestra. Who knows but what a great art may be built up based upon the sense of smell, as music and painting are based upon the senses of feeling and sight? In this new aesthetic field upon which men are just now entering, the perfume of the flowers may play a most important part.

—*Gardener's Chronicle* (New York).

Executors of the estate of the late Luther Burbank estimate the value of his estate in the neighborhood of \$200,000. It was left entirely to his widow. She will continue the experimental gardens assisted by persons who have been in the employ of Burbank for many years. Stanford University is endeavoring to establish an endowment fund for the purpose of taking over these gardens and it is the opinion that it will be successful in its efforts.

—*American Florist* (Illinois).

A few weeks ago we published an article on the carob tree and its edible pod for livestock feed. Each year we import shiploads of the meal from Southern Europe, and New York brokers annually send out quotations when shiploads arrive.

—*Cultivator* (California).

COLLEGE NOTES

Saturday August 21, 1926, was Siam Day at the College, marked by the visit to the College of Agriculture of H.S.H. Prince Dhani Nivat and H.S.H. Princess Siphon, accompanied by the Siamese students of Manila. Adding to these the five Siamese students attending the colleges here, the party was composed of some twenty-five members. The Prince and Princess made a thorough inspection of the College, and expressed keen interest in everything. This was followed at noon by a social gathering of the entire party, in charge of the resident Siamese students.

August 19, Admiral Bencke, retired German Admiral who is touring the world, made a short visit to the College. He expressed himself as much pleased with everything he saw.

Mr. Ichiro Kanazawa, Professor of Spanish in Tokyo Gaikoku Gogakko, and Professor T. Inouye of the Taipeh Normal School of Formosa were among recent visitors to College.

On September 3, on the invitation of Governor Perez of Tayabas, a number of coconut growers and members of the Legislature representing coconut regions met at Lucena, the capital of the province.

Professor Elayda of the Extension Service, Doctor Aldaba of Fiber Division, and Professor Henares of the Department of Chemistry represented this College. Professor Henares took with him his recently devised copra dryer. This simple kiln, the use of which means high grade copra, was the center of interest at the convention. It won not only warm praise for Professor Henares but commendation for the College, as being an institution of practical as well as theoretical results.

Doctor Roxas of the Department of Chemistry has issued some interesting and valuable popular leaflets on copra and its improvement and the coir possibilities in the Philippines. Papers on these subjects are in preparation and will be published in THE PHILIPPINE AGRICULTURIST in the near future.

From Java, from Australia, and from New Zealand come interesting reports of the work being conducted by Dean Russell, of the International Education Board. It is evident that the contemplated fellowships for

scientific workers are going to be very welcome; and there is a general appreciation of the need of some such agency to promote the interchange of experience and ideas. The relative development of agricultural education in the various countries in this part of the world is very diverse—how diverse, we are just beginning to realize.

Word comes from Dr. Miguel Manresa, university fellow in animal husbandry, that he was recently elected into Phi Sigma, honorary biological society, and Sigma Xi, scientific research society. Doctor Manresa's problem is on the isolation of a strain of rabbits resistant to contagious abortion. He is studying in the University of Wisconsin.

The twenty-first scientific meeting of the Los Baños Biological Club was held on August 26, 1926, at 8 o'clock in the evening in the College of Agriculture Auditorium.

The following papers, which will be presented in full at the coming Third Pan-Pacific Congress in Tokyo, were read and discussed:

- Dr. L. B. Uichanco. "Insects in relation to the introduced cultivated element of the Philippine flora."
 - Dr. Marcos Tubangui. "Laboratory studies on surra with especial reference to the nature of the immunity following the cure of experimental infections."
 - Dr. B. M. Gonzalez. "Experience in the Philippines with the introduction of pure bred animals to improve the common stock."
 - Dr. N. B. Mendiola. "Natural crossing in rice and its relation to rice improvement."
-

The Ranchers' Club, an association of students majoring in animal husbandry, celebrated Ranchers' Day on August 21, 1926. The festivities started in the morning with a live stock parade in which animals raised by the Department of Animal Husbandry were either ridden or led in parade around the Campus; floats in the parade gave diversion. Then followed a program featured by songs by the ranchers and addresses by Mr. Fernando Ordoveza, governor of the Club, Dr. F. M. Fronda, adviser of the Club, Dr. B. M. Gonzalez, head of animal husbandry department, and the heads of the two other Colleges in Los Baños, Doctor San Agustin, Dean of College of Veterinary Science, and Prof. O. W. Pflueger, of the School of Forestry. Dean Baker was scheduled to speak, but was occupied at the time with the entertainment of royal visitors from Siam. The elaborate program of athletics planned for the afternoon had to be suspended on account of the rain. The day closed with a grand ball in the Auditorium which was well attended by out of town guests as well as those from the College community.

On August 14, Mr. Dionesio I. Aquino, graduate assistant in the Soils Division, Department of Agronomy, sailed from Manila for the United

States. For three years Mr. Aquino has been the chief assistant in the soils division, where he has served well in the soils work as well as doing much of the photographic work for the College. He has gone at his own expense, expecting to do graduate work in soils in the Iowa Agricultural College, Ames, Iowa.

The new building of the College of Veterinary Science, on the opposite side of the main avenue from the present buildings of the College, is progressing nicely. Its architecture is of the attractive, yet utilitarian, style so extensively used by the College of Agriculture. The completion of this building will be of no small advantage to our College, because it will permit all of the Veterinary College staff to be located there, thus relieving the rear wing of the Pathology-Entomology Building, and the Tobacco House, for the strictly agricultural work for which they were intended.

The College has opened a new tract of land for a student barrio, which will afford building sites for individual students or groups who desire to erect their own houses. This is a very desirable move, because the present Copeland Heights site has practically no vacant land left that may be used for houses. And the College is desirous of having as many of the students as possible live on the Campus, even though the dormitory capacity is entirely inadequate.

Mr. Pablo Z. Quizon, B. Agr. '25, who has been in the employ of the Philippine Sugar Association, at San José, Mindoro, for over a year, writes that he is resigning from that post. Mr. Quizon has had charge of an extensive rat poisoning campaign in addition to his work with the fertilizer and other experiments in cane cultivation.

The Investigation Division, Bureau of Forestry, and the College of Agriculture, are co-operating in the erection of a wood distillation plant. The plant is located to the rear and west of the present Chemistry Building, and is to be housed in an attractive building of strong materials with concrete posts. This location, close to the Chemistry Department, is to facilitate the chemical control of the processes, which is so necessary in research work in destructive distillation.

The College is to have an adequate gas plant. The gasoline gas generators that have been in use have never been satisfactory, particularly in that the cost of the gas has been very high. Just recently there has been received from Calcutta, India, a Mansfield gas plant, for the manufacture of gas for laboratory purposes from kerosene or other cheap oils. The ship-

ment includes the retort and furnace, two gas holders, and the necessary piping and accessories. The plant is so designed that additional units may be added to meet the demands of the College, as it grows.

The College Cooperative Company has been enlarging its building. The extra room accommodates a tailor—one more step toward taking care of all of the students' needs on the Campus.

Mr. Luis S. Sol de Villa, B. S. Agr. '26, now teaching in Western Visayan Academy, a private school in Pototan, Iloilo, writes Mr. David of the Agronomy Department as follows:

Although I am teaching, I am at the same time putting in practice my knowledge gained from the College, by giving information to some of the farmers of this town. They are interested in growing cacao because of the high price of this crop. I am thankful that I took the cacao course while in College.

But I regret that I did not take the course in tobacco under you. Cultivation of tobacco is gaining in popularity among the farmers here, because of the increasing demand and the high price of tobacco. Information concerning cultivation, etc., can not be answered by me because of lack of knowledge. However, in matter of soil requirement and diseases, I can say a little.

The prominence of this important crop gives rise to a new post in the internal revenue office at Iloilo. This post is tobacco inspector. The only qualified men for examination are the College of Agriculture graduates and those who have had ten years' experience in the service. This is supposed to be a chance, but the trouble is that I have not taken the course in tobacco.

Mr. David, I ask your help. Will you be kind enough to provide me some of your pamphlets or books about tobacco. Lecture notes will do also. Examination questions will be taken on cultivation, curing and grading of tobacco. Grading will be the one used in Cagayan Valley.

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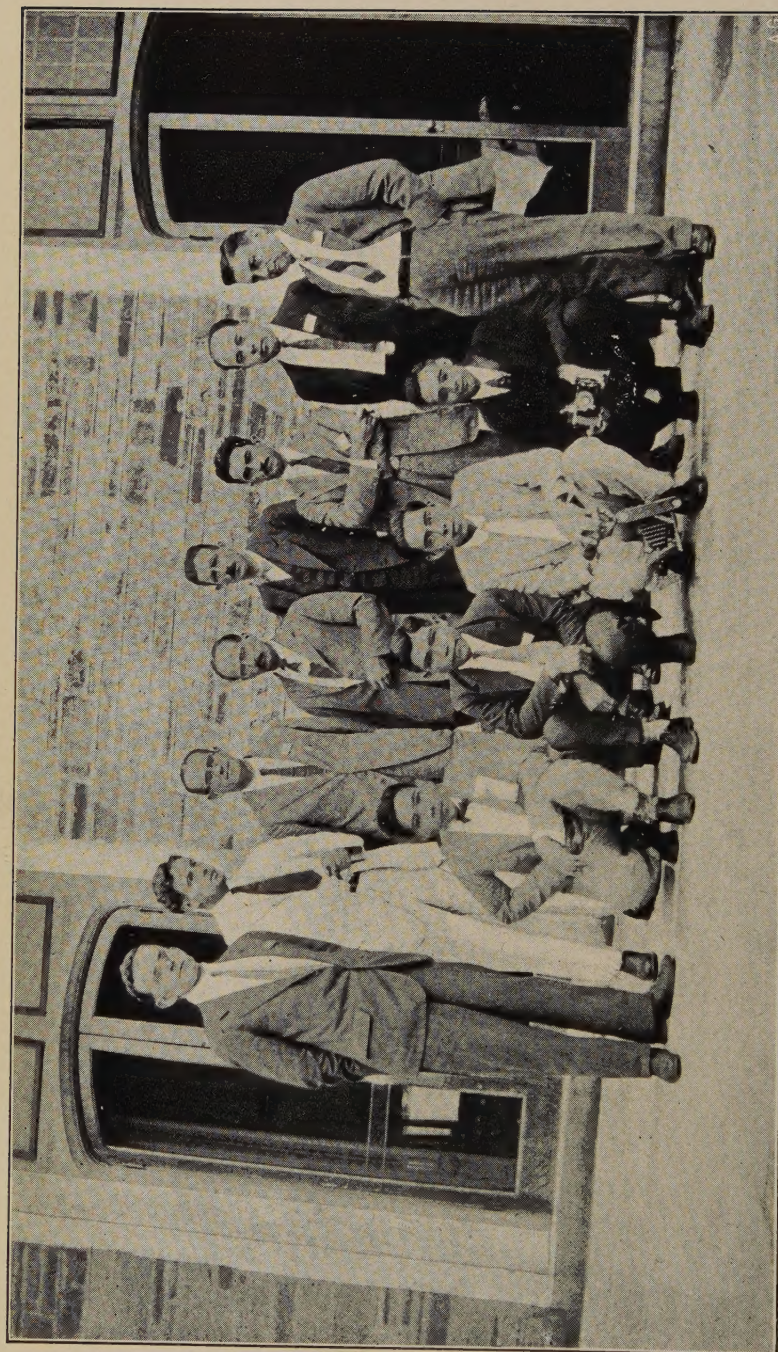
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Outlines of chordate development. 1913.
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Foot power loom weaving. 1924.
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SCIENTISTS OF FAR EASTERN SERVICE

*Standing, left to right:—*Dr. F. T. McLean, Dr. C. D. de la Rue, Dr. R. D. Rands, Dr. F. C. Gates, Mr. Herbert Copeland, Prof. F. P. McWhorter, Dr. Sam. F. Trelease, Dr. Wm. H. Brown. *“On the go,” left to right: Mr. Juan de G. Rodriguez, Mr. Julian A. Agati, Mr. Alexander Gordon, Mr. Felipe T. Adriano.*